Existing and Desired Condition

DRAFT Specialist Report

for the

Anderson Mesa Landscape Scale Assessment, Vegetation Group

Vegetation, Soils, Fire, and Select Pathogens

Resource/Subject Matter Analyzed

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Name and Title ***(please sign)*** **Date**

Existing Condition of Vegetation and Soils

Introduction

The objective of this report is to identify and describe existing and general desired conditions of vegetation and soils as well as functions and processes that influence vegetation and soils in the Anderson Mesa Landscape. Disturbances such as fire and insects/disease, ungulate grazing, logging and fuelwooding will also be identified, described and assessed. Appropriate information from this report can be copied and pasted into the Anderson Mesa Landscape Assessment. This report will be included in the Project Record in its entirety.

A goal of the Anderson Mesa Landscape Scale Assessment is to complete a comprehensive document that describes the existing and desired conditions and ecosystem functions. This document is not a Decision document (EA, EIS, etc.) with proposed projects, but rather a compilation of data that identifies those ecosystem functions that are working and those that are not, and suggestions for restoring functions that are broken.

Anderson Mesa is a unique area for its grassland and wetland habitat. It lies between the extensive pine country of the Mogollon Rim and the high desert of the little Colorado River-Basin. It is an area of limited rainfall making grass and forb productivity variable from year to year. Over the past century, the mesa has lost significant grassland acreage due to invasion of the pinyon and juniper woodland as a result of a variety of disturbances or lack thereof. The entire mesa is geographically defined by 4 watershed boundaries; and there are common, repeated vegetative types throughout. It is large in scale, covering approximately 263,451 [illegible]es.

There are 8 unique vegetation types (Table 1X Anderson Mesa LSA Vegetation Types, TES Units and Acreage) identified on the mesa ranging from pinyon-juniper woodlands at the lowest elevations to small acreages of mixed conifer at the highest elevations. The vast majority of soils are derived from basalt forming clayey textured subsoils and either thin loam surfaces or clay loam surfaces. Most areas along the eastern portions of the landscape are formed in limestone and have loamy textures with limestone bedrock generally less than 40 inches from the surface. Existing vegetation types result from differences in soil type, climate and disturbances.

This report is organized by an Introduction section, Field Survey/Resource Contacts section with methodologies and definitions used, Existing Condition and Desired Condition section followed by Adequacy of Forest Plan section. The bulk of the report will describe the existing conditions and ecosystem functions of vegetation, soils, and disturbances by identified vegetation type. Included in the existing condition section is information and statements pertaining to properties of vegetation composition and ground cover that would be expected under the potential plant community (ppc). This information can serve as sideboards in establishing the capability of the soil and vegetation for the identification of desired condition. The ppc is the plant community of the most advanced type (usually in late seral stage) capable of development under and in dynamic equilibrium with the prevailing environment. It usually represents the latest seral stage capable of supporting healthy vegetative composition, diversity and productivity under conditions of little to no human caused disturbance.

Field Surveys/Resource Contacts

Vegetation and soil types were derived from the Forest Ecological Unit Inventory, The Terrestrial Ecosystems Survey (TES) of the Coconino National Forest, 1995. The TES is the result of the systematic analysis, mapping, classification and interpretation of terrestrial ecosystems also known as ecological types delineated and numbered in ecological units. It is the only seamless mapping of vegetation and soils available across the Forest that includes field visited, validated and correlated sites with a stringent Regional and National protocol stemming from decades of work. Major field work for the TES was completed during the period of 1987 through 1991. Soil names and descriptions were approved in 1992. Map units are identified by numbers ranging from 41 to 654 on Anderson Mesa. Map units are phases of ecological units and are named for both soils and plants.

It is important to realize that differences in ecosystem properties including soil and vegetation can occur within short distances. The TES was mapped at a scale of 1:24,000 across the landscape in a rather broad-brush approach. Generally, small vegetation types smaller than about 10 to 40 acres were not mapped and are included in larger TES map units. For this reason, many small wetlands identified in the wetland section of this assessment were not mapped by the TES. For more accurate and complete information on location and condition of wetlands, please refer to the wetland section of this assessment.

Individual map units were based on data collected across the Forest and may or may not represent landscape existing conditions and potential plant community as depicted in the TES. Overall accuracy of mapping and information provided by the TES is considered reliable at the ecological unit or landscape level. Confidence limits are defined as statistical expressions of the probability that a biophysical property or the composition of an ecological map unit will vary within the class limits of taxonomic units and cartographic standards (Terrestrial Ecosystem Survey of the Prescott National Forest, April, 2000). Due to the inherent complexity and variability of natural systems, specific criteria to determine confidence limits are incorporated within the methodology in which a terrestrial ecosystem is conducted. On-site inspections and further refinement are recommended for detailed, project specific planning and proposals.

The TES includes the existing condition of the soil, vegetative overstory and ground cover. Existing vegetative conditions including canopy covers by species and ground covers were compiled and summarized from field notebooks and are used in this report. Many sites were visited and documented during the life of the TES on Anderson Mesa. In addition, the TES includes the potential plant community (ppc) by species, and vegetative ground cover predicted in the potential.

The published TES identifies the potential plant community (ppc) and is based on documented reference sites Forest and Region-wide. **The ppc does not represent desired vegetative conditions but serves as a capability sideboard to identify vegetation composition, diversity and vegetative ground cover that could exist.** The TES was selected as the primary tool to identify vegetation types and ecosystem functions because it describes both existing and reference type conditions, both of which will be described in the Anderson Mesa LSA. The ecological type and boundaries mapped by the TES serve as the basis for existing and potential vegetation type boundaries and analysis. Boundaries of ecological units depend on the interrelationship between soil, vegetation and climate and will remain mostly static in both the

short and long-term because climate has not and probably will not drastically change from the end of the TES (1992) to the present or near future.

It is important to realize the published TES map unit name identifies and describes the potential plant community (ppc) and not the present vegetation type. The 8 vegetation types identified and described in this LSA are existing vegetation types based on available data collected and analyzed and are aligned more or less towards lifezones.

Other Field Surveys Used and Resource Contacts:
Because the published TES does not provide detailed, published existing vegetation species composition, and diversity information, substantial effort has been undertaken to describe each vegetation type based on recently collected and analyzed information. This information comes from summarized TES field notebooks, range clusters, ecological monitoring, botanical surveys, recent AMP's and environmental documents including Bar-T-Bar –Anderson Springs DEIS, Picket-Padre DEA, Forest Stand database, NAU Forest Ecosystem Restoration and Analysis (FERA) data and public input. Additional existing condition information used includes vegetation and soil condition data collected and analyzed by range, watershed, other resource specialists and the public Citizens Working Group, stand exam information in timbered areas, aerial surveys of bark beetle kill, TE&S Plant Narratives (2003), Ricketson, Mezulis(2002),and Loeser(1997-2002).

The Sisk Lab of Applied Ecology at Northern Arizona Universities FERA program provided critical landsat generated vegetation information on exiting canopy cover on the mesa. This information was used to supplement the TES collected canopy cover information and served as a tool to more accurately identify existing vegetation types and canopy cover descriptions.

Information provided by public comment during the 2003 open houses was included in the analysis of existing and desired conditions. This information includes narrative comment and description of existing vegetation type, canopy cover, and soil condition. In several instances, comments referring to location were drawn on map overlays and used in the identification and description of existing vegetation type and soil condition. Comments collected during open houses referring to existing and desired conditions expressed an interest to reduce tree canopy cover in dense pinyon-juniper types and pinyon-juniper/grassland transitions. As a result, and combined with TES and FERA data, two vegetation types were split out where the vegetative potential seems to support lower stand densities and higher herbaceous understories than currently exists. Additional comments received indicated a desire to reduce fuelwood poaching.

Desired conditions previously identified by the collaborative group Diablo Trust were included in this report and pertain to those areas described in the section entitled, ***Diablo Trust Future Landscape/ Resource Base Goals*** later in this report.

Desired conditions previously identified by the East Clear Creek Ecosystem Assessment collaborative group are also included in this report and pertain to those areas located in the East Clear Creek watershed. These conditions are located in the section entitled, ***ECC Final Vision Statements*** later in this report.

Definitions and Methodologies Used

Vegetation Types: The method used in determining the TES ecological type and vegetation type is dependant on the integration of information from the fields of soil science, plant ecology and climatology and are derived from the TES.

Vegetation type nomenclature: based on the vegetative subseries present as described in the TES Handbook, 4/25/86. The first part of the name consists of a conspicuous plant of the overstory. Other plants may be added to indicate an important diagnostic species that is dominant or codominant in the overstorys or understory. At least one plant in the name should serve to distinguish the vegetative type from adjoining types along the same climatic gradient. Other plant names are added to characterize the uniqueness of the vegetative type with respect to climatically equivalent types or differences in soil. Major differences in soil type are reflected in the vegetation composition and type present.

Vegetative ground cover: included in this assessment and defined as the sum of vegetative basal area and litter (greater than 1"). To be effective at retarding sheet and rill erosion, litter must be greater than about one-half inch. At the time of TES survey data collection, effective litter was presumed to be greater than 1 inch. Current experience and direction indicates litter greter than about one-half inch is effective at protecting the surface from accelerated erosion.

Canopy cover: refers to the percent crown coverage of trees, shrubs, forbs or graminoids at a given location.

Table X Existing and Potential Vegetative Ground Cover (VGC) and Tree Canopy Cover displays existing, effective vegetative ground cover (litter greater than 1 inch) with vegetative ground cover under potential (normal years of precipitation and little disturbance) conditions by vegetation type. Vegetative ground cover information is important because it is a manageable component in the protection of surface soil erosion.

Descriptions of Columns listed in Table X correspond to the following information:

TES EXISTING VGC (RANGE) PERCENT: This column displays the range of existing vegetative ground cover values taken from measured values collected Forest-wide (although most of the data is from locations in or near Anderson Mesa) during the TES and from on-site data collected on Anderson Mesa in more recent years.

TES EXISTING VGC (AVERAGE) PERCENT: These values list the overall average of vegetative ground covers from TES measured values found across each vegetation type.

TES PPC VGC PERCENT: These values are taken from the TES and express conditions that can be expected under the potential plant community in normal years of precipitation.

FERA EXISTING TREE CANOPY COVER PERCENT: These values are taken from FERA generated satellite imagery taken in 1997 and display the range of existing tree canopy covers across many vegetation types. Eastern portions of the mesa did not have satellite coverage and therefore lack data. Existing tree canopy covers as predicted by the TES can be found in the TES. For a detailed tree canopy cover map produced from FERA, **please see the Project Record # XX**.

TES PPC TREE CANOPY COVER PERCENT: These values display potential tree canopy cover taken from predicted TES canopy cover percents under the PPC and are expressed as the range of values found across the vegetation type.

Shrub and herbaceous (forbs and graminoid) canopy covers are also included in this report and are found under the heading **Canopy Cover** in each of the 8 vegetation types**.** Herbaceous and shrub canopy cover was taken from TES data measured and averaged across the Forest from 1987 – 1992 and from recent air photo interpretation and on-site observations and data collected. Species composition, diversity, and productivity were largely taken from the TES, range cluster analysis, and botanical surveys.

Soil Condition:

An important component of watershed condition and landscape health is soil condition. The Terrestrial Ecosystem Survey (TES) for the Coconino National Forest (USDA, 1995) was the basis for this soil condition assessment. Soil condition as listed in the TES is based primarily on quantitative on-site erosion rates (stability) measured and predicted by the Universal Soil Loss Equation, (USLE). Since its publication in 1995, a new approved soil condition protocol was developed in R3 (FSH 2509.18-99-1) assessing three soil functions including the ability of the soil to resist erosion, infiltrate water and recycle nutrients. Due to a lack of newer data assessing all three-soil functions, soil condition on many TES map units is based primarily on the ability of the soil to resist erosion. Most of these areas are located in ponderosa pine or pinyon-juniper vegetation types. However, numerous refined on-site soil condition assessments were made primarily on slopes of less than 15 percent and in select pinyon-juniper, grassland and meadow types because of Forest specialist and public concern and knowledge of soil function.

In single component TES map units, or in multiple component units with the same soil condition class, one soil condition call per map unit is made. In the multi-component TES map unit 515, we used the more limiting component (in a reduced soil condition class) since the aerial percentage was 30 percent or more. All other map units have multiple components by map unit design and therefore have dual soil condition classes. These units have the predominant soil condition class listed first.

Definitions:

Unsatisfactory/Impaired**:** This is a dual soil condition class. The majority of the aerial extent is probably unsatisfactory soils but have almost equal amounts of impaired soils (described below). For unsatisfactory soils, indicators signify that a loss of soil function has occurred. Degradation of vital soil functions result in the inability of the soil to maintain resource values, sustain outputs or recover from impacts. Unsatisfactory soils are candidates for improved management practices or restoration designed to recover soil functions.

Impaired**:** Indicators signify a reduction in soil function. The ability of the soil to function properly and normally has been reduced and/or there exists an increased vulnerability to degradation. An impaired category indicates there is a need to investigate the ecosystem to determine the cause and degree of decline in soil functions. Changes in land management practices or other preventative measures may be appropriate.

Impaired/Unsatisfactory**:** This is a dual soil condition class. The majority of the aerial extent is probably impaired soils but have intermingled areas with unsatisfactory soils. The definitions and management implications of impaired and unsatisfactory soils are listed above.

Satisfactory: Indicators signify that soil function is being sustained and soil is functioning properly and normally. The ability of the soil to maintain resource values and sustain outputs is high.

Satisfactory-Inherently Unstable: These soils have natural erosion exceeding tolerable limits. Based on the Universal Soil Loss Equation (USLE) these soils are eroding faster than they are renewing themselves but are functioning properly and normally.

FIRE REGIME CONDITION CLASS DEFINITION

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Hardy et al. (2001) and Schmidt et al. (2002) defined course-scale historical fire regimes. Hann and Bunnel (2001) interpreted these course-course scale regimes for use in fire and fuels management. The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. These five regimes are defined as:

I – 0-35 year frequency and low (surface fires most common) to mixed severity (less than 75% of the dominant overstory vegetation replaced);
II – 0-35 year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);
III – 35-100+ year frequency and mixed severity (less than 75% of the dominant overstory vegetation replaced);
IV – 35-100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced);
V – 200+ year frequency and high (stand replacement) severity.

The degree of departure from the natural fire regime of any given site is known as the fire regime condition class (FRCC). Departure from the natural fire regime results in changes to at least one of the following: vegetative characteristics; fuel composition; fuel arrangement; fire frequency; fire severity; fire pattern; other pathogens; nutrient cycling and water cycling. This assessment uses three FRCC's based on low, moderate, and high departure from any of five the natural fire regimes (Hann and Bunnell 2001, Hardy et al. 2001, Schmidt et al. 2002). The condition classes are defined as:

Condition Class 1: Fire regimes are within the natural range and the risk of losing ecosystem components is low. Vegetative attributes are intact and functioning within the natural range.

Condition Class 2: Fire regimes are moderately altered from their natural range. Ecosystem components have a moderate risk of loss. Fire frequencies are departed from natural frequencies by one or more return intervals (either more or less frequent) resulting in moderate changes to at least one of the following: fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes are moderately altered from the natural range.

Condition Class 3: Fire regimes are substantially altered from their natural range. Ecosystem components have a high risk of loss. Fire frequencies are departed from natural frequencies by multiple return intervals. Dramatic changes occur to at least one of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes are substantially altered from the natural range.

Fire regimes and condition classes for the vegetation types found on Anderson Mesa have not been formally assessed in the field. Therefore, further discussion of fire regime and condition class by vegetation type in this document is qualitatively based on literature review and professional opinion and is subject to change following field assessment.

Valuable Internet Links Tiered To.

http://alic.arid.arizona.edu/tes/tes.html This link is the published TES manuscript and is located under publications on the Coconino National Forest internet site http://www.fs.fed.us/r3/coconino/publications/index.shtml.

It links to basic information about the survey, Coconino National Forest and links to a list of all the map units within the Coconino National Forest. Clicking on a map unit number will take you to all the information which defines the map unit including soil classification and mapping legend in table 1, map unit properties and descriptions of the predicted potential plant community in table 2, and interpretations including production potentials, limitations and hazard ratings for selected uses and soil loss rates modeled across the Forest and landscape by map unit.

Existing and Desired Condition by Vegetation Type:

35 TES map units were aggregated into 8 vegetation types. Table 1X shows the vegetation type; associated acres and TES map units aggregated.

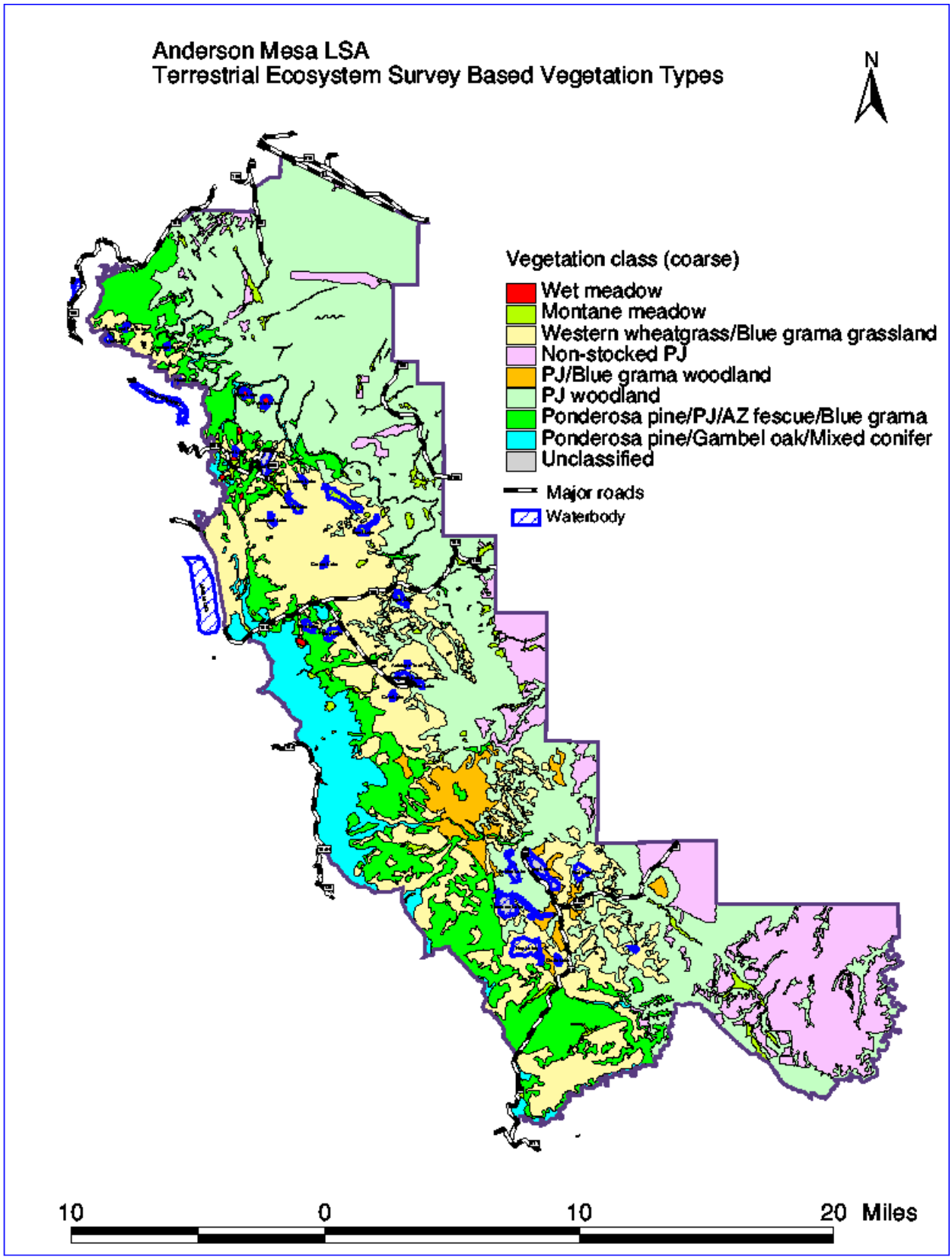
Table 1X Anderson Mesa LSA Vegetation Types, TES Units and Acreage

New Vegetation Type	TES Map Units	Acres
Wet Meadows	50	464
Montane Meadows	41, 53, 55	5508
Western Wheatgrass/Blue Grama Grasslands	453, 515	55,044
Non-Stocked Pinyon-Juniper	436, 454	32,250
Pinyon-Juniper /Blue Grama Woodlands	438, 440	6664
Pinyon-Juniper Woodlands	433, 434, 435, 437,439, 441, 455,465, 490, 491	109,627
Ponderosa Pine/PJ/AZ Fescue/Blue Grama	500, 523, 524, 527	35,810
Ponderosa Pine/Gambel Oak	550,555, 654, 565, 567, 575, 578, 579, 582, 584, 585, 586	16,446
Water		1638
Total Acres		263,451

See Figure 2(below), Anderson Mesa TES Based Vegetation Classifications displays the 8 vegetation types in the landscape. Descriptions of vegetation, soil, and disturbances including fire and pathogens follow Figure 2.

The TES can be found by following this link, http://alic.arid.arizona.edu/tes/tes.html. It displays soil classification by TES map unit found within each vegetation type. The classification follows the 6th approximation of Soil Taxonomy and is mapped to the soil family level.

Figure 2. Anderson Mesa TES Based Vegetation Classifications.



1. Wet Meadow (sedge, spikerush, rush)

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type occurs in basins, and lowland plains that are saturated long enough to have wetland characteristics including hydric soils and hydrophytic vegetation. It is located throughout the central portion of the landscape and includes **TES map unit 50**. Approximately 15 delineations totaling 464 acres are identified by the TES. This vegetation type includes seasonal and semi-permanent wetlands and one upland site inaccurately mapped. In most instances, there is a transition from one wetland type in the lowest portion of the landscape to a drier wetland type in higher lying areas of the wetland.

Due to the scale of mapping, the TES did not include all wetlands identified in the wetland section of this assessment. The TES labels this vegetation type as sedge/spikerush/rush without bulrush. Other data collected on the mesa indicate semi-permanent wetlands have high amounts of bulrush while seasonal wetlands do not. The TES vegetation class does not represent all wetland types on the mesa and therefore is difficult to accurately assess the wetland vegetation on the mesa with the ppc predicted in the TES. However, information from the TES may be useful for comparisons in similar vegetation types. On-site investigations were made to more accurately assess the vegetation type of identified wetlands. For a more detailed assessment of identified wetlands and their characteristics in the landscape, **please see section XX (Existing Condition of Wetlands).**

Elevational Range: 6900 – 7200 feet
Precipitation Range: 19 – 22 inches

Composition by Lifeform: There is no overstory of trees or shrubs in this type. The herbaceous layer is dominated by grasslike species including sedge *(Carex* spp. *L.)*, spikerush *(Eleocaris* spp. *R. Br.)* and includes bulrush (*Scirpus acutus.)* in semi-permanent wetlands and the wettest sites. Perennial grasses are generally absent due to excessive moisture. Western wheatgrass (*Pascopyrum smithii* (Rydb.) A. Löve) and foxtail barley (*Hordeum jubatum* L.) may occur on the transition between wetland and non-wetland areas. Existing forbs include Mexican dock (Rumex *salicifolius* Weinm. var. *mexicanus* (Meisn.) C.L. Hitchc.), and ragweed (*Ambrosia* spp.) For a broad list of vegetation in this vegetation type and in other wetlands on Anderson Mesa, please see the wetland section of this assessment or the Ricketson's plant list in the **Project Record # XXX**.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing more forage than all other vegetation types in the landscape.

Canopy Cover: The canopy cover of the herbaceous layer ranges from about 2% in periods of dry years to over 70% in periods of normal years of precipitation. As designed by the TES and for sedge/spikerush/rush-dominated sites (may closely approximate semi-permanent wetlands), about 75 - 80% is expected at ppc during years of normal precipitation. For spikerush-dominated sites and seasonal wetlands, the ppc canopy cover could be 0% during dry years although not defined in the TES. There is no tree or shrub canopy cover.

Vegetative Ground Cover: Vegetative ground cover ranges from 0% in periods of dry years to about 80% in periods of normal years of precipitation with about 75% expected at ppc during

normal or wet years, and depending on the wetland type. Areas dominated by bulrush in semi-permanent wetland types have ground cover at 75 – 100 %. Seasonal wetland types have ground covers on the lower end of the range. As designed by the TES and for sedge/spikerush/rush-dominated sites, about 90% is expected at ppc during periods of normal years of precipitation. For spikerush-dominated sites and seasonal wetlands, the ppc vegetative ground cover could approach 0% during periods of below normal periods of precipitation although not defined in the TES.

Soil Morphology and Classification: These soils are classified as Vertic Haplaquolls, fine, montmorrillonitic, frigid, are deep (greater than 40 inches to bedrock), have clay surface textures, and may be seasonally ponded. These soils are derived in alluvium from basalt and cinders and are very clayey throughout their profile.

These soils are classified as Mollisols and meet the criteria for hydric soils. They have high amounts of organic matter in the surface horizon, exhibit characteristics of seasonally saturated soils and have anaerobic conditions in the upper part of the soil profile. These soils are ponded and saturated long enough to have hydrophytic vegetation present and therefore meet the definition of wetlands. Many of these soils have seasonal surface cracking due to very high clay percentages which causes accelerated drying of the subsoil.

Soil Condition: Overall, soil condition is variable (impaired and satisfactory) depending on the wetland type. Semi-permanent wetlands have satisfactory soil conditions where bull rush dominates. Soil condition in semi permanent wetland types signifies that soil function is being sustained and soil is functioning properly and normally. Observations and limited documentation indicates soil nutrient cycling and hydrologic functions are satisfactory in bulrush dominated semi-permanent wetland areas. However, transitional portions of these wetlands are dominated by spikerush and have soil conditions similar to seasonal, temporary, or ephemeral wetlands described below. These spikerush dominated transitional areas are too small to delineate at the landscape level scale.

Observations and limited documentation indicate seasonal, temporary, ephemeral and spikerush dominated areas of semi permanent wetlands have impaired soil conditions based on reduced ability of the soil to infiltrate water. Slight to moderate alteration of surface soil structure (blocky, or platy aggregation) was observed in several wetlands and probably caused by ungulate hoof action during periods when the soil was wet. A desired soil structure would be well-aggregated granular soil in the upper few inches. Soil nutrient cycling is variable but generally satisfactory and responses directly to climatic conditions for all wetland types. During periods of below normal precipitation, vegetative productivity and litter is very low or almost absent resulting in reduced nutrient cycling. During periods of normal or above precipitation, vegetative productivity and litter rebounds to high levels causing high nutrient cycling. Further on-site data may be needed to more accurately assess nutrient cycling following years of normal or above precipitation.

Although many wetlands show signs of altered surface structure, soil conditions and wetland function can improve in the short or long-term if proper ungulate grazing strategy is combined with normal or above years of precipitation. The result would be improved soil structure and infiltration resulting in more plant available water in the soil and consequent improved vegetation productivity. More on-site soil investigations would have to be conducted to assess site-specific soil condition due to variability in disturbances and soil management.

Ecological Condition (EC and PPC compared): As of spring, 2003, most seasonal or spikerush dominated wetland sites have current canopy cover of grasslike species and vegetative ground cover significantly less than what might be expected under the ppc although conditions have not been defined. The diversity of plant species is probably somewhat less than but close to what is expected in the ppc although not defined. Semi-permanent wetlands appear to have canopy covers at or near their potential in periods of normal years of precipitation. The soil is most susceptible to surface alteration and compaction when it is wet. These wetlands have the ability to improve surface soil structure, infiltration, and organic matter content by allowing natural revegetation, root growth, and decomposition to occur under a proper ungulate grazing and normal climate.

Disturbances (Human, Fire and Pathogens, Drought, Flooding, if appropriate):

As of spring, 2003, the composition of grass like species and forbs is much less than what would be expected under the ppc primarily due to several years of below average precipitation. Current composition is probably about normal for these dry conditions. Past levels of ungulate grazing (livestock and elk) (historically much higher than current) combined with current grazing strategies and drought have probably contributed to reduce the herbaceous understory plant composition, diversity, productivity, and effective vegetative ground cover (Briske D.D. 1991; Szaro, R.C. et al 1999; Archer, S. et al 1991). Wetlands with stock, pit tanks serve as a water attractant for ungulates and frequent grazing location. These stock tanks alter the hydrology in the wetland basin (see explanation in wetland section). Recent drought, high levels of past grazing coupled with current levels of ungulate grazing, and stock tanks located in wetlands have cumulatively reduced vegetation composition and productivity.

Fire Regime and Condition Class. The condition class of riparian communities on Anderson Mesa is unknown. Fire does not usually directly influence riparian communities and therefore is a rare event within these communities. However, fire frequency (rarity) may be decreasing due to the effects of fire exclusion, grazing, and other human influences on the condition class of adjacent vegetation types. Increased fire intensity, severity, and extent in areas adjacent to riparian communities may increase the risk for severe fire within riparian communities.

Noxious weeds and invasive exotic plants. The extent of noxious weed infestations in wet meadows on Anderson Mesa is unknown. Wet meadows typically receive heavy use from grazing animals and humans. This heavy use can increase the risk of invasion by providing a continued and increased level of disturbance. Additionally, propagules can enter these areas on animals or through various methods of human dispersal. Several species could potentially infest wet meadow areas on the Mesa. For example, sporadic infestations of cheatgrass (*Bromus tectorum* L.) and annual exotic mustards including tumble mustard (*Sisymbrium altissimum* L) and spreading wallflower (*Erysimum repandum* L.) occur in several areas of the mesa. These infestations could spread into wet meadow areas of the Mesa. For a more complete discussion of noxious weeds and invasive exotic species, please refer to the Botany Specialists Report in the Project Record.

2. Montane Meadow

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type occurs in basins and lowland plains throughout the landscape and includes **TES map unit 41, 53, and 55**. It includes 3 Montane Meadow types. For specific descriptions of each, please see Project Record. Additional field investigation of TES mapping identified a few ephemeral, temporary or seasonal wetlands not mapped as wetlands in the original TES. For a more detailed assessment of identified wetlands and their characteristics in the landscape, **please see section XX (Existing Condition of Wetlands).**

There is about 5508 acres identified by the TES. These landforms may be seasonally ponded but are not saturated long enough to have wetland characteristics such as hydric soils or hydrophytic vegetation whereas the wetlands do.

Elevational Range: 6000 – 7100 feet
Precipitation Range: 16 – 22 inches

Composition by Lifeform: There is no overstory of trees and only small amounts of shrubs present in this type. Encroachment of ponderosa pine is occurring in a few areas. Shrubs are generally less than 5% with canopy covers of winterfat (*Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse & Smit) ranging from 0 – 20% and rubber rabbitbrush [*Ericameria nauseosa* (Pallas ex Pursh) Nesom & Baird] less than about 2% and only in select sites. The herbaceous layer is dominated by graminoids with only small amounts of forbs. Dominant graminoids may include Kentucky bluegrass (*Poa pratensis* L.), spike muhly (*Muhlenbergia wrightii* Vasey ex Coult.), western wheatgrass (*Pascopyrum smithii* (Rydb.) A. Löve), spikerush and sedge in wetlands, Canada bluegrass, foxtail barley, sand dropseed *(Sporobolus cryptandrus* (Torr.) Gray), blue grama (*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths), muttongrass [*Poa fendleriana* and wolftail (*Lycurus phleoides* Kunth). Other graminoids may include needle and threadgrass (*Hesperostipa comata* (Trin. & Rupr.) Barkworth), bottlebrush squirreltail (*Elymus elymoides* (Raf.) Swezey), mountain muhly [*Muhlenbergia montana* (Nutt.) A. S. Hitchc.] and orchardgrass *(Dactylis glomerata* L).

Existing forbs generally have less than about 2 - 5% canopy cover and may include scarlet globemallow (*Sphaeralcea coccinea* (Nutt.) Rydb.), red root buckwheat *(Eriogonum racemosum* Nutt.), lupin, white sagebrush (*Artemisia ludoviciana* Nutt.) buckwheat (*Eriogonum* Michx), western yarrow (*Achillea millefolium* L. var. *occidentalis* DC.), pussytoes (*Antennaria* Gaertn.), clover *(Melilotus* P. Mill.), Wright's deervetch [*Lotus wrightii* (Gray) Greene], purple geranium (*Geranium caespitosum* James). and Russian thistle (*Salsola spp*. L.). Horsetail (*Equisetum* L.) and rush (Juncus spp. L.) are found in wetter microclimates in the lowest depressional area too small to delineate at 1:24,000.

For wetlands located in this type, there is no identified ppc but in periods of normal or above years of precipitation, it probably would be somewhat similar to but have lower vegetative productivity than the sedge, spikerush bulrush vegetation type with little or no existing bulrush.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing more forage than ponderosa pine forests, stocked, and non-stocked pj woodlands, and western

wheatgrass/ blue grama grassland vegetation types on the mesa but less than wet meadows in the landscape.

Canopy Cover: The canopy cover of the herbaceous layer ranges from less than 5% in periods of dry years to about 75% in periods of normal years of precipitation with about 25 - 75% expected at ppc in normal years of precipitation. There is no tree canopy cover but some sites have up to about 5% canopy cover of shrubs mostly from winterfat or rabbitbrush in select sites.

Vegetative Ground Cover: Vegetative ground cover ranges from 5% in periods of dry years to about 80% in periods of normal years of precipitation. About 55 - 90% is expected at ppc for periods of normal years of precipitation. It is not known what the vegetative ground cover would be under years of below normal precipitation.

Soil Morphology and Classification: Major components of these soils are classified as Cumulic Haplustolls, fine-loamy, mixed mesic, deep, fine sandy loam surfaces, Pachic Argiustolls, fine, mixed, mesic, deep loam surfaces, Pachic Argiborolls and Vertic Argiborolls, fine, montmorillonitic with loam and clay loam surfaces. These soils are classified as Mollisols and are indicative of grassland soils. They have very thick (>16 inches) of dark surfaces high in organic matter (>1%) are formed from alluvium and are deep (>40 inches to bedrock) and have loamy or clayey textures with low amounts of rock fragments throughout. Field refinement of numerous basins indicate that a few of these soils are within ephemeral, temporary or seasonal wetlands and have hydrophytic vegetation present and meet hydric soil criteria. They exhibit characteristics of seasonally saturated soils with anaerobic conditions in the upper part of the soil profile. Soils located in closed basins without hydrophytic vegetation do not meet the definition of hydric soils and therefore are not wetlands.

Soil Condition: Soil conditions may vary across the landscape but generally are impaired due to a decrease in nutrient cycling function or the ability of the soil to infiltrate water. Identified ephemeral, temporary and seasonal wetlands in this type have soil condition similar to those described for Wet Meadows. Herbaceous understory composition, diversity, productivity and vegetative ground cover have been reduced. These soils generally have somewhat blocky or platy surface soil structure in the soil surface caused primarily by ungulate alteration of the surface. There may be areas with unsatisfactory soils. Soils clayey throughout and those classified as Vertic (very high clay soils) have seasonal surface cracking due to very high clay percentages which causes accelerated drying of the subsoil. On-site soil investigations would have to be conducted to assess site-specific soil condition due to variability in disturbances and soil management. Revegetation potential is high on these soils.

Ecological Condition (EC and PPC compared): In most places, the current canopy cover of perennial grasses and forbs are much less than what is expected in the ppc. This is due in large part to extended years of drought. The diversity of graminoids and forbs is much less than what is expected in the ppc. Most sites are dominated by a few perennial species. The soil is most susceptible to surface compaction when it is wet. Grazing wetlands under moist soil conditions should be avoided. The few wetlands identified in this type have the ability to improve surface soil structure, infiltration, and organic matter content by allowing natural revegetation, root growth, and decomposition to occur under a grazing strategy within the carrying capacity.

Disturbances (Human, Fire and Pathogens, if appropriate): Recent drought and high levels of past ungulate (primarily livestock and elk) grazing have cumulatively reduced herbaceous understory composition, diversity, productivity and effective vegetative ground cover (especially

litter). Current ungulate grazing is probably reducing (although to a lesser extent due to lower stocking rates) overall plant productivity and effective vegetative ground cover. Past, and most likely to a lesser extent, current grazing pressure has caused some compaction of the soil surface resulting in decreased water infiltration and increased runoff. This reduction of vegetative ground cover and slightly higher runoff has cumulatively increased the susceptibility for wind, sheet and rill erosion although the water erosion hazard is still slight due to flat slopes.

Fire Regime and Condition Class. Grasslands on Anderson Mesa are in condition class 2 - 3. The historic fire regime has been altered due to multiple missed fire intervals. There is also some evidence of change in species composition in the grassland communities that may have resulted from human activities. Potential fire intensity, severity, extent and duration have increased while fire frequency has decreased in areas subject to encroachment by woody species. Grasslands having reduced herbaceous cover without encroachment have decreased potential for fire occurrence, intensity, severity, extent, and duration due to a lack of sufficient fuel with which to carry fire.

Noxious weeds and invasive exotic plants. This unit is also subject to weed invasions. Spreading wall was found in many locations in this unit during the field season of 2003. In some areas, this species formed large monocultures. Tumble mustard and cheatgrass were also observed in some parts of this unit. The recent drought and past grazing practices addressed in the disturbances section may have contributed to the invasions of these three species through the creation of bare soil. The presence of annual mustards and cheatgrass together may work together to increase the fire risk on the Mesa. This risk is more completely addressed in the Botany Specialist's report located in the Project Record.

3. Western Wheatgrass-Blue Grama Grasslands (pinyon-juniper lifezone)

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type occurs throughout central and southern portions of the landscape on elevated plains with an average slope of about 3%, and includes **TES map units 453 and 515**. It includes two similar Grassland types. For specific descriptions of each, please see Project Record. This vegetation type has small acreages associated with treated (pushed, chained, or fuelwooded woodland areas) that are presently in this seral grassland stage. There are about 55,044 acres as identified by the TES.

Elevational Range: 6200 – 7300 feet
Precipitation Range: 14 – 22 inches

Composition by Lifeform: Ponderosa pine**,** pinyon-juniper and shrub overstory is usually less than about 5% in this type. The herbaceous layer is dominated by graminoids with lesser amounts of forbs. Dominant graminoids may include (generally from highest to lowest canopy covers) western wheatgrass, blue grama, bottlebrush squirreltail, mutton grass, and june grass (Koeleria sp. Pers.). Other graminoids may include, three awn (*Aristida* L.), slender wheatgrass (*Elymus trachycaulus* (Link) Gould ex Shinners) and other species. Existing forbs generally have less than about 5% canopy cover and may include fringed sage (*Artemisia frigida* Willd.), astragalus, fleabane, globemallow, pingue rubberweed (*Hymenoxys richardsonii* (Hook.) Cockerell), white sagebrush, Wright's deervetch, western yarrow, pussytoes, American vetch

(*Vicia americana* Muhl. ex Willd), milkweed (*Asclepias* sp. L.), western dandelion, Asteraceae silvery lupine (*Lupinus argenteus* Pursh), flax (*Linum* spp. L.), redroot wild buckwheat, pussytoes, wee Mary buckwheat (*Eriogonum jamesii* Benth.), Indian paintbrush (*Castilleja* spp.Mutis ex L. f.) and other species.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing more forage than pinyon-juniper woodlands, about the same as non-stocked woodlands, and less forage than all montane or wet meadows in the landscape.

Canopy Cover: The canopy cover of the herbaceous layer ranges from about 2% to about 40% with values on the higher end of the range during periods of normal years of precipitation. 30 – 45 % is expected in the ppc. Overall, there is only a trace of tree or shrub canopy cover and a few stringers of ponderosa pine or pinyon-juniper in select areas

Vegetative Ground Cover: Vegetative ground cover ranges from about 3% -55% with higher values during periods of normal years of precipitation. About 35% is expected at ppc.

Soil Morphology and Classification: Major components of these soils are classified as Vertic Haplustalfs, fine, montmorillonitic, mesic, deep, Typic Argiustolls, clayey-skeletal, montmorillonitic, mesic, moderately deep, cobbly and very cobbly loam surfaces and Vertic Argiborolls, fine, montmorillonitic, deep, cobbly clay loam surfaces. Most of these soils (more than 45 – 85%) are classified as Mollisols and are indicative of grassland soils. The exception is the Vertic Hapustalf. They have thick, dark surfaces high in organic matter (>1%). These soils are formed from residuum derived from basalt and cinders and vary in depth (>20 - 40 inches to bedrock) and have clayey textures with variable amounts of rock fragments throughout. Many of these soils have seasonal surface cracking due to very high clay percentages which causes accelerated drying of the subsoil.

Soil Condition: Soil conditions may vary across the landscape but generally are impaired and unsatisfactory signifying a reduction in soil function. In general, loam surfaces (Typic soils) seem to be more compacted (indicated by platy structure and loss of porosity) than clay surface textures found in Vertic soils and consequently rate our as unsatisfactory more often. On-site soil condition assessments generally show current soil conditions have the ability to resist water erosion but have reduced ability to infiltrate water or recycle nutrients. Soils with granular clay loam surfaces have high wind erosion hazard and are susceptible to increased soil loss. Although not quantified, undocumented field observation indicates it is possible that the majority of on-site erosion comes form wind and not water.

Impaired soil condition areas have reduced ability to recycle nutrients or infiltrate water. Herbaceous understory composition, diversity, productivity and effective vegetative ground cover (especially litter) have been reduced, and/or these soils may have somewhat blocky or weak, platy surface soil structure due primarily to past and to a lesser extent, current ungulate grazing.

For unsatisfactory soil condition areas, indicators signify that a loss of soil function has occurred due to major reduction in the ability of the soil to infiltrate water or recycle nutrients. These soils have platy, or near massive surfaces and poor herbaceous understory and vegetative ground cover. The limiting ground cover factor appears to be very low amounts of litter cover. (On-site soil investigations would have to be conducted to assess site-specific soil condition due to

variability in disturbances and soil management. The water erosion hazard is moderate. Revegetation potential is limited by clay textures at or near the surface.

Ecological Condition (EC and PPC compared): In most places, the current canopy cover of perennial grasses is somewhat less than the 30 - 45% canopy expected in the ppc. This is likely due to recent drought. It is unknown what the ppc canopy cover would be during periods of drought. In addition, the diversity of perennial grasses and forbs is somewhat less than the ppc prediction. Most sites are dominated by a few perennial graminoids.

Disturbances (Human, Fire and Pathogens, if appropriate): Past and likely to a lesser extent, current grazing pressure coupled with lower amounts of protective surface litter has caused some compaction of the soil surface resulting in decreased water infiltration and increased runoff especially in areas with unsatisfactory soils. Recent drought and high levels of past ungulate grazing have cumulatively reduced herbaceous understory composition, diversity, productivity and effective vegetative ground cover (especially litter). Current ungulate grazing is probably reducing (although to a lesser extent due to lower stocking rates) overall plant productivity and effective vegetative ground cover. This reduction of vegetative ground cover and higher runoff has cumulatively increased the susceptibility for wind, sheet and rill erosion although the water erosion hazard is still slight due to flat slopes.

Grazing (removal of fine fuels that historically carried wildfires) and exclusion of wildfires has allowed some expansion of trees and shrubs into areas that were historically grasslands.

Fire Regime and Condition Class. Grasslands on Anderson Mesa are in condition class 2 - 3. The historic fire regime has been altered due to multiple missed fire intervals. There is also some evidence of change in species composition in the grassland communities that may have resulted from human activities. Potential fire intensity, severity, extent and duration have increased while fire frequency has decreased in areas subject to encroachment by woody species. Grasslands having reduced herbaceous cover without encroachment have decreased potential for fire occurrence, intensity, severity, extent, and duration due to a lack of sufficient fuel with which to carry fire.

Noxious weeds and invasive exotic plants. Known weed infestations in this unit include spreading wallflower, cheatgrass and common mullein (*Verbascum thapsus* L.) However, other weed species may occur. Spreading wallflower and common mullein undoubtedly benefit from bare soil created by reduced vegetation cover. Annual mustards such as spreading wallflower may increase fire risk by depositing fine litter on the soil surface. Over time, this litter could accumulate and increase fire risk. Additionally, large infestations of this species created monocultures and occupied growing space more appropriately occupied by desirable native species. It has been theorized that annual mustards and cheatgrass may interact and increase fire interval and severity. Additionally, cheatgrass alone is a poor source of forage when mature, unlike native species it replaces. Common mullein is an exotic species and levels of infestation of this species tend to be sporadic, as conditions permit. Reduction of bare soil through establishment of healthy native grasslands would reduce the probability of mullein infestations. For a more complete discussion of noxious weeds and invasive exotic plants, the reader should consult the Botany Specialists Report located in the Project Record

4. Non-Stocked Pinyon-Juniper Woodlands

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type occurs throughout eastern portions of the landscape on elevated plains with an average slope of about 2 -4%, and includes **TES map unit 436 and 454**. It includes two similar Non-Stocked PJ Woodland types but the majority of the acres are associated with TES map unit 436. For specific descriptions of each, please see the Project Record. This vegetation type is associated with treated (pushed or chained woodland areas) and are presently in this seral grassland stage. There are about 32,250 acres as identified by the TES.

Elevational Range: 5900 – 6500 feet
Precipitation Range: 14 – 18 inches

Composition by Lifeform: Pinyon-juniper overstory is usually absent or has regenerating saplings establishing. Shrubs are dominated by cliffrose [*Purshia stansburiana* (Torr.) Henrickson] (specifically in TES map unit 436), Fremont barberry [*Mahonia fremontii* (Torr.) Fedde] and rubber rabbitbrush in select areas. Other shrubs may include banana yucca (*Yucca baccata* Torr)., broom snakeweed [*Gutierrezia sarothrae* (Pursh) Britt. & Rusby], pale wolfberry (*Lycium pallidum* Miers), plains prickly pear (*Opuntia polyacantha* Haw), and other shrub species. Areas located in TES map unit 454 have sparse shrubs.

The herbaceous layer is dominated by graminoids with few forbs present. Dominant graminoids may include (generally from highest to lowest canopy covers) blue grama, crested wheatgrass [*Agropyron cristatum* (L.) Gaertn.], (variable in location, **Open house Identified many areas lack this grass, CWG item)**, and bottlebrush squirreltail. Other graminoids may include mutton grass, ring muhly [*Muhlenbergia torreyi* (Kunth) A.S. Hitchc. ex Bush], spike muhly, cheatgrass (*Bromus tectorum* L.), needle and threadgrass, Indian ricegrass and other species. Existing forbs generally have less than about 1% canopy cover and may include fringed sage, globemallow, thistle (*Cirsium* spp. P. Mill.), four o-clock (*Mirabilis* spp. L), horehound (*Marrubium vulgare* L.), plantain *(Plantago* spp. L.), trailing fleabane (*Erigeron flagellaris* Gray), sago lily, redroot wild buckwheat and other species.

Productivity: Under conditions that approximate the ppc under sustained treatment of overstory, these soils are capable of producing more forage than pinyon-juniper woodlands, and less forage than all montane and wet meadows, and western wheatgrass/blue grama grasslands.

Canopy Cover: Tree overstory has been removed leaving less than about 5% of trees and less than about 6% of shrubs. The canopy cover of the herbaceous layer ranges from about 15% to about 40% with values on the higher end of the range during periods of normal years of precipitation. About 40 - 45% is expected in the ppc during periods of normal years of precipitation. If the overstory would not be treated, about 30% would be expected in the ppc.

Vegetative Ground Cover: Vegetative ground cover ranges from 5 – 65% with about 40 - 50% expected in the ppc. Values would be on the higher end of the range during periods of normal years of precipitation.

Soil Morphology and Classification: Major components of these soils (TES map unit 436) are classified as Lithic Ustochrepts, loamy-skeletal, carbonatic, mesic, shallow, gravelly fine sandy

loam and Calcic Ustochrepts, fine-loamy, carbonatic, mesic, moderately deep, gravelly fine sandy loam surfaces. Major components of these soils (TES map unit 454) are classified as Typic Haplustalfs, fine, montmorillonitic, mesic, deep, and Calcic Ustochrepts, fine-loamy, calcareous, mesic, moderately deep, gravelly loam surfaces. These soils are indicative of calcareous woodlands and have thin, organic surfaces. The soils are highly calcareous with pH's generally above 8.0 throughout. These soils are formed from residuum and alluvium derived from limestone or sandstone, have variable depth to bedrock (< 20 – more than 40 inches) and have loamy or sandy loam textures or are clayey (TES map unit 454) with variable rock fragments throughout.

Soil Condition: Soil conditions are generally satisfactory but were not field refined and are based on the ability of the soil to resist erosion as evaluated and predicted by the TES. These soils probably have the ability to resist accelerated water erosion and may be functioning properly and normally. It is possible that areas of impaired soils exist. On-site soil investigations would have to be conducted to assess site-specific soil condition.

These soils have a high wind erosion hazard due to calcareous surface soils, and slight to moderate water erosion hazard. Although not quantified, undocumented field observation indicates it is possible that the majority of on-site erosion comes from wind and not water. Revegetation potential is limited by calcareous soils. Selection of seed should consider the calcareous nature of the soil.

Ecological Condition (EC and PPC compared): In most places, the current canopy cover of perennial grasses is less than the 40 - 45% canopy expected in the ppc for chained areas. Areas in TES map unit 454 have perennial grass cover much less than the ppc predicts. The effect of past treatment (chaining or pushing pj overstory) has improved the productivity of the herbaceous understory in some places but overall, this vegetation type does not have grassland potential. In addition, the diversity of perennial grasses is low but the composition of existing graminoids is about equal to what would be expected in the ppc. Forb composition and diversity is variable but generally, poorer than what is predicted in the ppc. Most sites are dominated by a couple of perennial and annual species.

Disturbances (Human, Fire and Pathogens, if appropriate): This vegetation type is associated with treated (pushed or chained woodland areas) and are presently in this seral grassland stage. Recent drought, and past ungulate grazing have slightly reduced the herbaceous understory composition, diversity, productivity and effective vegetative ground cover. Current ungulate grazing is probably reducing (although to a lesser extent due to lower stocking rates) overall plant productivity and effective vegetative ground cover. Areas with reduced vegetative ground covers are more susceptible to wind, sheet and rill erosion.

Fire Regime and Condition Class. The fire regime and condition class for this vegetation type are not well known due in part to a lack evidence of pre-European species composition and structure in relation to the role of fire on the landscape. The historic fire regime has been probably been altered however due to missed fire intervals and due to mechanical vegetative manipulation. The potential for fire occurrence under the current conditions (including drought effects) and management is very low in this vegetation type due to lack of herbaceous fuel and the amount of exposed soil and rock.

Noxious weeds and invasive exotic plants. The extent and severity of noxious weed and invasive exotic infestations in this unit are unknown. However, past disturbance history, prevailing

drought and reduction of vegetative ground cover make these areas more susceptible to invasion by weedy species. Many noxious weeds and invasive exotics are thought to benefit from bare ground and reduced competition from other species. Therefore, the three factors mentioned would benefit noxious weeds or invasive exotics. For a complete discussion of noxious weeds and invasive exotics on the Mesa, please review the Botany Specialist's Report located in the Project Record.

5. Pinyon-Juniper Woodlands

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type is the most extensive in the landscape occurs throughout the landscape on elevated plains, hills, escarpments and mountains with slopes ranging from about 2 – 120%. It includes five similar pinyon-juniper types. For detailed descriptions of these types, please see the **Project Record # XX**. It includes **TES map units 433, 434, 435, 437, 439, 441, 455, 465, 490, 491**. There are about 109,627 acres as identified by the TES.

Composition by lifeform This type has variable pinyon-juniper overstories in early to late seral stages but overall has dense canopy covers exceeding the ppc. The overstory is dominated by one-seed juniper or Utah juniper with much lower amounts of pinyon pine indicating an imbalance in composition as compared to the ppc. Most trees are junipers less than about 90 years old with lesser amounts of pinyon pine seedlings found under nurse juniper trees. Overall, this type is probably in early-mid seral stage. In higher elevations, TES map units 490, and 491 (24,577 acres) have gambel oak and alligator juniper present and reproducing successfully (greater than about 5% canopy cover). In select areas, especially in the eastern portions of this type, recent bark beetle kill has infected and killed pinyon pines causing a shift to near monoculture juniper stands. There are many areas **(CWG identify)** in late seral stage than have dense canopy covers and some areas with very low canopy covers, particularly in northern areas of this type **(CWG ID). Please see Figure X, FERA Canopy Cover Map** for canopy covers in this type. Areas with tree canopy covers exceeding about 40% negatively affect the amount and distribution of understory vegetation. Shrubs may include skunkbush sumac, Fremont barberry, pincushion cactus, prickly pear, yucca, broom snakeweed, redroot buckwheat, wax currant *(Ribes cereum Dougl.)*, and cliffrose in eastern portions on TES map units. 434, 435, 437, and 455 and other species.

The herbaceous layer is dominated by graminoids with many fewer forbs present. The herbaceous layer is normally dominated (generally from highest to lowest canopy covers) by blue grama, bottlebrush squirreltail, western wheatgrass, mutton bluegrass, junegrass and sideoats grama. Other perennial grasses are scarce but may include three-awn, mountain and ring muhlys and dropseed, red brome, needle and threadgrass. Forbs may include Wright's buckwheat *(Eriogonum wrightii* Torr. ex Benth.), groundsel, bitterweed, aster, fleabane, globemallow, fringed sage, astragalus, mustard, false springparsley, plantain and other species.

Elevational Range: 6200 – 7100 feet.
Precipitation Range: 14 – 20 inches.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing less forage than Pinyon-Juniper Blue Grama Woodlands, all montane and wet meadows, and western wheatgrass/blue grama grasslands.

Canopy Cover: Tree canopy cover is variable and ranges from about 15% to over 80%. Several areas (particularly in the southern portion of the landscape **(Check with CWG)** have canopy cover ranging from 40 – 70 %. Please see the **Project Record # XX** for a detailed map of tree canopy covers as produced by FERA. The canopy cover of the herbaceous layer is variable and generally low depending on precipitation and tree canopy cover.

Vegetative Ground Cover: Vegetative ground cover ranges from 5 – 65% with 45 - 50 % expected in the ppc.

Soil Morphology and Classification: Major components of these soils are classified as Typic and Vertic Haplustalfs, fine, or clayey-skeletal, montmorillonitic, mesic, deep, with cobbly to extremely cobbly clay loam or loam surfaces. Other soils are Lithic Haplustalfs, loamy-skeletal, mixed, mesic,shallow, sandy loam surfaces with variable rock fragments. Soils in eastern portions of this type are Lithic and Typic Ustochrepts, loamy-skeletal, carbonatic or calcareous, mesic, shallow or moderately deep, fine sandy loam surfaces. All soils are indicative of woodland and have thin, organic surfaces. These soils are formed from residuum derived from basalt and cinders or limestone or sandstone with variable depth and are clayey or loamy textures throughout. Soils derived in limestone or sandstone (eastern areas) are loamy and calcareous throughout and have pH's commonly above 8.2. Some of these soils have seasonal surface cracking due to very high clay percentages which causes accelerated drying of the subsoil.

Soil Condition: Soil conditions are variable and include all classes from unsatisfactory to satisfactory. Please refer to **Figure X Refined Terrestrial Ecosystem Soil Condition** for specific locations and the section **Summary of Soil Condition by TES Map Units:** for narrative descriptions within this type.

Limited field data and observations near the central and eastern part of the mesa indicate soil conditions are unsatisfactory for major components once pj canopy cover exceeds about 40%. High canopies effectively out compete and reduce the herbaceous understory, and protective litter resulting in decreased decomposition and nutrient cycling, compaction and accelerated erosion. See FERA canopy cover map for specific locations. In areas where pj canopy cover is less than about 40%, soil conditions are generally unsatisfactory on Typic soils and impaired on Vertic soils. Field observations indicate Typic soils generally have a higher degree of platy surface structure than Vertic soils. Vertic soils commonly have a loose, granular surface due to high clay percentages and poor aggradatation likely caused by hoof degradation of surface structure. Slope ranging from about 0 – 5% probably have the ability to resist accelerated water erosion. Steeper slopes in dense woodlands generally have low amounts of effective vegetative ground cover and show evidence of sheet and rill erosion. On-site soil investigations would have to be conducted to assess site-specific soil condition across the entire landscape.

Clayey surfaces have a high wind erosion hazard especially for poorly aggradated surface structure. Calcareous surfaces (located in eastern portions of this type) have high wind erosion hazard also. These soils have slight to severe water erosion hazard. Although not quantified, undocumented field observation indicates it is possible that the majority of on-site erosion comes from wind and not water. Revegetation potential is limited by those soils with clay textures at or near the surface or those soils with highly calcareous surfaces.

Ecological Condition (EC and PPC compared):
The higher proportion of juniper relative to pinyon pine may be due to past drought (1950's and current) and lack of fire necessary to maintain interspaces and a more equal proportion of pinyon juniper predicted in the ppc. Juniper appears to have expanded over much of the area. Bark beetles have attacked and killed pinyon pine and some ponderosa pine throughout the assessment area. Fire exclusion, resulting from and combined with grazing, has limited the ability of fire to maintain early to mid seral stages in grasslands and open canopy woodlands (<40% canopy closure) by controlling establishment of woody species.ire combined with past excessive grazing may have the ability of fire to carry ground fuels necessary to maintain herbaceous interspaces and reduce juniper.

Shrub composition and diversity are generally in balance with their ppc. In areas with tree canopy covers lower than about 20 -30%, the herbaceous understory is somewhat less than or close to graminoid and forb composition relative to the ppc. In areas with denser tree canopy covers, graminoid and forb composition and diversity is much lower than the ppc and will not improve as canopies continue to close. In addition, the diversity of perennial grasses and forbs is generally poor throughout the landscape. Most sites are dominated by a few perennial graminoids and annual forbs.

Where tree canopy cover exceeds about 40%, herbaceous understory and vegetative ground cover decreases significantly impairing soil condition and vegetative and soil productivity. **In these areas (CWG),** there may be opportunity to thin out overstocked woodlands through fuelwood cutting, lop and scattering techniques to improve sol and vegetative conditions. In areas with canopy cover less than about 10%, and especially in areas adjacent to other grasslands and in northern areas of this type, there may be opportunity to manage towards grassland-dominated ecosystems

Disturbances (Human, Fire and Pathogens, if appropriate): Recent drought and high levels of past ungulate grazing, and lack of natural fire have cumulatively reduced the ability of water to infiltrate soil and has reduced the herbaceous understory composition, diversity, productivity and effective vegetative ground cover (especially litter). Current ungulate grazing is probably reducing (although to a lesser extent due to lower stocking rates) overall plant productivity and effective vegetative ground cover. For unsatisfactory soils, past and to a lesser extent, current grazing pressure has caused compaction of the soil surface and slight compaction for impaired soils resulting in variable decreased water infiltration and increased runoff. Fire exclusion has contributed to overstocked trees and less herbaceous understories. This reduction of vegetative ground cover and higher runoff has cumulatively increased the susceptibility for wind, sheet and rill erosion.

In select areas (especially in TES units 434, 435, 437, and 455), bark beetles kill have attacked and killed pinyon and ponderosa pines.

The frequency of low intensity wildfires in PJ has been reduced slightly. Overstory stocking levels have increased in PJ as a result of reduced fire related mortality rates in young trees. Many of these trees would have died during low intensity fire events as they occurred historically. Increased overstory stocking has reduced understory stocking in grasses and forbs that helped carry low intensity fires, particularly in woodlands with historically open, clumpy overstory tree structure and substantial herbaceous cover in openings between clumps of trees.

Fire Regime and Condition Class. Pinyon/juniper stands on Anderson Mesa are in condition classes 2 or 3. The historic fire regime has been altered due to fire suppression and removal of herbaceous component by ungulate grazing and drought. Potential fire intensity, severity, extent and duration have increased in stands with high canopy cover, particularly stands subjected to bark beetle activity. Fire frequency is relatively unchanged in stands where the historic carrier of fire was tree litter. Fire frequency has decreased and multiple intervals have been missed in stands where the historic carrier of fire was herbaceous litter (ie: stands with <40% canopy cover historically).

Noxious weeds and invasive exotic plants. The extent of noxious weed and invasive exotic plant infestations in this unit is unknown. Species such as cheatgrass could exist in the interspaces or possibly under juniper trees. The recent deaths of pinyon trees that have succumbed to bark beetles have provided numerous sites that may be at risk for invasion if propagules of undesirable species are available.

6. Pinyon-Juniper Blue Grama Woodlands

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type occurs throughout southcentral portion of the landscape on elevated plains with an average slope of about 3%, and includes **TES map unit 438 and 440**. There are about 6664 acres as identified by the TES.

Elevational Range: 6500 – 7200 feet
Precipitation Range: 16 – 18 inches

Composition by Lifeform. The overstory is dominated by one-seed juniper with lesser amounts of Utah juniper and alligator juniper and much lower amounts of pinyon pine indicating an imbalance in composition as compared to the ppc. This type is probably in early-mid seral stage. In select areas, recent bark beetle kill has infected pinyon pines and will cause a shift to higher relative amounts of juniper. Some areas have fairly dense canopies exceeding the ppc **(please see Figure X, FERA Canopy Cover.** Shrubs may include Fremont barberry, pincushion cactus *(Mamillaria spp.)*, prickly pear, broom snakeweed, yucca and other species.

The herbaceous layer is dominated by graminoids with fewer forbs present. The herbaceous layer is normally dominated by (generally from highest to lowest canopy covers) blue grama, bottlebrush squirreltail, western wheatgrass, and mutton bluegrass. Other perennial grasses may include junegrass, three-awn, side-oats grama and other species. Forbs may include, Wright's buckwheat, globemallow, lupine, redroot wild buckwheat, cudweed sagewort, fleabane, mustard, Indian paintbrush, and other species.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing a little more forage than other woodlands but less than all meadows and grasslands.

Canopy Cover: Tree canopy cover is variable and exceeds 40 - 60%. Please see the **Project Record # XX** for a detailed map of tree canopy covers as produced by FERA. The canopy cover of the herbaceous layer ranges from about 3 – 30% with about 20 – 25% expected at ppc.

Vegetative Ground Cover: Vegetative ground cover ranges from 3 – 40% with 40 - 45% expected at ppc.

Soil Morphology and Classification: Major components of these soils are classified as Typic Argiustolls, fine or clayey-skeletal, montmorillonitic, mesic, deep, with very cobbly clay loam surfaces. These soils are indicative of grasslands **(please see Figure X Mollisol (Grassland Soils) Identified by the TES)** and have thick, dark surfaces high in organic matter (>1%). These soils are formed from residuum derived from basalt and cinders are greater than 40 inches to bedrock and have clayey textures throughout. When these soils are bare, they may have seasonal surface cracking due to high clay percentages that causes accelerated drying of the subsoil.

Soil Condition: With the use of FERA canopy cover maps, a more precise prediction of canopy cover was made resulting in areas with satisfactory and areas of impaired soils. Undocumented and documented personal observations indicate nutrient cycling and ability to resist erosion becomes impaired once canopy covers approaches or exceeds the 40% range or the range predicted in the ppc. This is due to the reduction of herbaceous understory vegetation and litter that promotes decomposition and protects the soil from erosion. These soils have slight water erosion hazard. Rock fragments at or near the surface limit revegetation potential by machinery.

Ecological Condition (EC and PPC compared): The much higher proportion of juniper relative to pinyon pine may be due to drought (1950's and current) and lack of fire necessary to maintain interspaces and a more equal proportion of pinyon juniper predicted in the ppc. Fire exclusion, resulting from and combined with grazing, has limited the ability of fire to maintain early to mid seral stages in grasslands and open canopy woodlands (<40% canopy closure) by controlling establishment of woody species. Lack of fire combined with past excessive grazing has likely reduced the ability of fire to carry ground fuels necessary to maintain herbaceous interspaces and reduce juniper expansion.

It is apparent that these soils should support a highly productive herbaceous understory within large interspaces. Tree canopy expansion has limited the herbaceous understory.

Shrub composition is generally in balance with the ppc but diversity is somewhat lower. Higher than normal amounts of broom snakeweed coverage indicate high levels of past disturbance. The herbaceous understory is variable throughout the landscape. In general for perennial species present, the herbaceous understory is somewhat less than or close to graminoid and forb composition relative to the ppc but the diversity is usually lower. Most sites are dominated by few to several perennial species.

Where tree canopy cover exceeds about 40%, herbaceous understory and vegetative ground cover decreases significantly impairing soil condition and vegetative and soil productivity. **In these areas (CWG),** there may be opportunity to thin out overstocked woodlands through fuelwood cutting, lop and scattering techniques to improve soil and vegetative conditions and promote the grassland like interspaces.

In areas with low canopy cover and especially in areas adjacent to other grasslands, there may be opportunity to manage towards grassland-dominated ecosystems or manage for large interspaces with highly herbaceous understories.

Disturbances (Human, Drought, Flood, Fire, Pathogens, etc.) The 2002 and 2003 bark beetle has infected many pinyon pines in select areas. Recent drought and high levels of past ungulate grazing have cumulatively reduced the herbaceous understory composition, diversity, productivity and effective vegetative ground cover (especially litter) and nutrient cycling function. Current ungulate grazing is probably reducing (although to a lesser extent due to lower stocking rates) overall plant productivity and effective vegetative ground cover. Past and to a lesser extent, current grazing pressure may have caused slight compaction of the soil surface resulting in variable decreased water infiltration and increased runoff. Fire exclusion has contributed to overstocked trees and less herbaceous understories. This reduction of vegetative ground cover and higher runoff has cumulatively increased the susceptibility for wind, sheet and rill erosion.

The frequency of low intensity wildfires in PJ has been modified slightly. Overstory stocking levels have increased in PJ as a result of reduced mortality rates in young trees. Many of these trees would have died during low intensity events as they occurred historically. Increased overstory stocking has reduced understory stocking in grasses and forbs that helped carry low intensity fires.

The greatest impact that exclusion of wildfires has had on the PJ vegetation has been the exclusion of wildfire in areas that were historically grasslands or that had highly herbaceous understory interspaces. This has allowed pinyon and juniper to expand far beyond their historical boundaries while greatly decreasing the amount of area that had large, herbaceous understories or were grasslands. On sites with deeper soils where PJ was a natural component, pinyon and juniper trees existed as scattered mature trees over large expanses of grass. This "savanna" condition was maintained through the years by periodic low intensity fires that killed smaller trees and added nutrients to the soil, perpetuating the grasses.

Fire Regime and Condition Class. Pinyon/juniper stands on Anderson Mesa are in condition classes 2 or 3. The historic fire regime has been altered due to fire suppression and removal of herbaceous component by ungulate grazing and drought. Potential fire intensity, severity, extent and duration have increased in stands with high canopy cover, particularly stands subjected to bark beetle activity. Fire frequency is relatively unchanged in stands where the historic carrier of fire was tree litter. Fire frequency has decreased and multiple intervals have been missed in stands where the historic carrier of fire was herbaceous litter (ie: stands with <40% canopy cover historically).

Noxious weeds and invasive exotic plants. The extent of noxious weed and invasive exotic plant infestations in this unit is unknown. Species such as cheatgrass could exist in the interspaces or possibly under juniper trees. The recent deaths of pinyon trees that have succumbed to bark beetles have provided numerous sites that may be at risk for invasion if propagules of undesirable species are available.

7. Ponderosa Pine/Pinyon-Juniper/AZ Fescue/Blue Grama

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type occurs in the transition zone between pinyon-juniper woodlands and ponderosa pine forests and may have the highest species diversity on the landscape. It is located in western portions of the landscape and west of Ashurst Lake (TES map

unit 527). It occurs on elevated plains, hillslopes and scarp slopes of plains with slopes ranging from 0 – 40 %. It includes **TES map units 523, 524**, and one delineation of **TES map unit 527** and amounts to about 35,810 acres as identified by the TES. The majority of the acres are identified as TES map unit 523.

Elevational Range: 6500 – 7300 feet
Precipitation Range: 18 – 22 inches

Composition by lifeform: The overstory is variable and may be dominated by ponderosa pine, pinyon pine, or Utah juniper with lesser amounts of pinyon pine, one-seed juniper, gambel oak, and occasional presence of Rocky mountain juniper. Composition on some sites show ponderosa pine is dominant while on other sites, pinyon-juniper dominates. Some sites also lack alligator juniper.

Shrubs may include gambel oak generally greater than 5% cover, Fremont barberry, skunkbush sumac, cliffrose, Utah serviceberry, gray horsebrush, Oregon grape, prickly pear, yucca, skunkbush sumac, pincushion cactus, and other species. Cliffrose is common and fernbush may be present in areas within TES map unit 523, west of Ashurst Lake. The invader broom snakeweed is noticeable in many areas.

Graminoids may include (generally from highest to lowest) mutton bluegrass, bottlebrush squirreltail, junegrass, blue grama, with lesser amounts of sedge, spike and mountain muhly, western wheatgrass, three awn, Arizona fesuce, pine dropseed and other species. Dominant forbs may include, groundsel, globemallow, Wrights deervetch, trailing fleabane, mustard, cudweed sagewort, fineleaf hymenopapus, redroot wild buchwheat, rushpea, purple geranium, astaragalus, fendler meadow rue, mullein, sago lily and other species.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing less forage than the Ponderosa Pine/Gambel Oak type.

Canopy Cover: Tree canopy cover is variable and ranges from about 5 - 70% but more commonly ranges from 25 – 40% with about 50 - 55% expected in the ppc. Please see the **Project Record # XX** for a detailed map of tree canopy covers as produced by FERA. FERA shows canopy cover ranging from 20 – 70%. There are several areas with patches of canopy cover ranging from 5 – 10% (**ask CWG).** The canopy cover of the herbaceous layer generally ranges from <5 - 25% with about 10 - 20% expected at ppc.

Vegetative Ground Cover: Vegetative ground cover ranges from 5 - 90% with about 65 - 70% expected at ppc.

Morphology and Classification: Major components of these soils are classified as Typic and Mollic Eutroboralfs (TES map unit 523), and Typic Argiborolls, fine and clayey-skeletal, montmorillonitic, deep and moderately deep, very cobbly, and very stony clay loams and loams (TES map unit 524). TES map unit 527 is classified as Lithic and Typic Haploborolls, calcareous, loamy-skeletal, mixed, shallow and moderately deep, extremely cobbly fine sandy loams. These soils are indicative of forest soils with herbaceous, grassy interspaces. These soils have fairly thick, to thick, organic surfaces and are clayey and sometimes are rocky throughout. One or more major soil components or about 60 – 80% of the aerial composition have Mollisol or Mollic-like soils. TES map unit 523 has Mollic-like soils and have organic surfaces about 2 inches thinner than the Mollisols (TES units 523, and 527). It is believed that these soils still

have the capability to produce very herbaceous understories in the interspaces similar to TES units 524 and 527. Please see Figure X, Mollisols (Grassland Soils) Identified by the TES for locations. These soils are formed from colluvium and residuum derived from basalt and cinders and are 20 –more than 40 inches to bedrock.

Soil Condition: Soil condition is satisfactory. These soils have a slight to severe water erosion hazard. Maintenance of effective vegetative ground cover is essential on steeper slopes to prevent accelerated erosion.

Ecological Condition (EC and PPC compared): This vegetation type should have higher diversity than either the pinyon-juniper or ponderosa pine lifezone because it lies in the transitional ecotone between them. Tree and shrub canopy covers are variable but are generally less than what is predicted in the ppc (please see FERA canopy cover map in **Project Record # XX**). Overall diversity is close to but a little lower than the ppc for all layers. Many sites have high regeneration of ponderosa pine, pinyon, and gambel oak seedlings perhaps due to lack of natural fire. In this transition zone, ponderosa pine should dominate over pinyon juniper with total tree and shrub canopy covers. Because these soils are indicative of grassland-like soils, it is believed that the predicted TES potential tree canopy cover of 50 –55% is too high to produce desired highly herbaceous understories with large interspaces (pers, comm. Rory Steinke). A more reasonable ppc tree canopy cover might be more near the average of 25 – 40% to achieve a desired condition of highly herbaceous understories.

In areas with low canopy cover (less than about 15%) and especially in areas adjacent to other grasslands, there may be opportunity to manage towards grassland-dominated ecosystems or manage for large interspaces with highly herbaceous understories.

Overall, shrub composition is variable and diversity is close to or a little lower than the ppc for trees and shrubs. Flatter slopes seem to have poorer composition and diversity than steeper slopes possibly from greater grazing intensity and recreation disturbance. Slopes ranging from about 15 – 40 % have composition and diversity similar to the ppc. In some sites, broom snakeweed coverage indicates high levels of past disturbance.

Overall composition in the graminoid and forb layer is variable but generally somewhat less than or close to the ppc and diversity is close to the ppc. Most sites are dominated by several perennial species and sites with noticeable broom snakeweed coverage indicate high levels of past disturbance.

Disturbances (Human, Drought, Flood, Fire, Pathogens, etc.) Recent drought has reduced the herbaceous understory composition, and productivity and effective vegetative ground cover in some areas. The effects of past wildfire suppression has probably increased tree canopy cover in select areas.

Fire Regime and Condition Class. Ponderosa pine stands on Anderson Mesa are in Condition Classes 2 and, to a lesser extent, 3. The historic fire regime has been altered due to fire suppression resulting in multiple missed fire intervals. Potential fire intensity, severity, extent and duration have increased. Fire suppression has resulted in increased stand densities and, with the exception of recently established open grown trees, decreased growth and vigor of individual trees of all size classes. Decreased vigor results in increased susceptibility to pathogens and parasites such as drought, bark beetles and mistletoe. Large and small-scale patches of mortality have occurred over the past few years because of the aforementioned influences on tree vigor.

This mortality may increase the risk and hazard of future ignitions until the needles fall but will increase the potential surface fire intensity for many years as dead trees fall and become heavy surface fuel that will burn for long periods of time with localized high intensity.

Noxious weeds and invasive exotic plants. Noxious weeds and invasive exotic plants in this unit include but are not necessarily limited to spreading wallflower, cheatgrass, and mullein. These species were observed on the Mesa in 2003. Exotic annual mustards such as spreading wallflower and cheatgrass may interact to increase fire risk in areas where they exist together. Mullein is a sporadic exotic species that tends to form sporadic irruptions as conditions become favorable. Under these conditions, it occupies growing space and utilizes resources that would normally be used by native species. Healthy native plant communities are less prone to invasions and should be more resistant to such sporadic irruptions. Additional risks to areas in this habitat type include invasions from knapweeds, exotic thistles Mediterranean sage and other species that might be dispersed along roadways. This risk is based on the proximity to several major roads including Forest Highway 3.

8. Ponderosa Pine - Gambel Oak

Vegetation and Landscape Features:

Distribution and Extent: This vegetation type is located in the southwestern and west-central portions of the landscape and is found on elevated plains, hills with slopes ranging from about 0 – 40% and a few escarpments on slopes greater than 40%. It includes three similar ponderosa pine and mixed conifer types. The Mixed Conifer type only includes 529 acres and is located primarily in Jacks Canyon. For detailed descriptions of the pine types, please see the **Project Record # XX**.

This type includes **TES map units 550, 555, 565, 567, 575, 578, 579, 582, 584, 585, 586, and 654** and amounts to about 16,446 acres as identified by the TES.

Elevational Range: 6300 – 7800 feet
Precipitation Range: 19 – 26 inches

Composition by lifeform: The overstory is dominated by ponderosa pine with lesser amounts of alligator juniper and gambel oak. Rocky mountain juniper may be present.

Shrubs may include gambel oak, fendler ceanothus, woods rose, wax currant, New Mexico locust, snowberry, Oregon grape, pincushion cactus, agave, broom snakeweed and other species.

Graminoids may include (generally from highest to lowest) mutton bluegrass, bottlebrush squirreltail, sedge, junegrass, Arizona fescue, mountain muhly, western wheatgrass with lesser amounts of screwleaf muhly, pine dropseed, Kentucky bluegrass, blue grama, and other species. Dominant forbs may include, groundsel, lupin, American vetch, false springparsley, goldenrod, penstemon, bitterweed, buckwheat, lupin, western yarrow, pussytoes, phlox, Wrights deervetch, cudweed sagewort, and many other species. Cover becomes reduced with increased tree canopy cover.

Productivity: Under conditions that approximate the ppc, these soils are capable of producing a little more forage than the Ponderosa Pine/AZ Fescue/Blue Grama Transition type under the

higher ppc tree canopy covers (50 – 55%) primarily because it receives increased precipitation. If the Ponderosa Pine/AZ Fescue/Blue Grama Transition type is managed toward lower tree canopy covers, (less than about 25 -40%), the productivity of the ponderosa Pine/Gambel Oak type may be less.

Canopy Cover: Tree canopy cover ranges about 30 - 70% with about 55 - 70% expected in the ppc. Please see the **Project Record # XX** for a detailed map of tree canopy covers as produced by FERA. The canopy cover of the herbaceous layer generally ranges from <5 - 10% with about 15 - 25% expected at ppc.

Vegetative Ground Cover: Vegetative ground cover ranges from 30 - 95% with about 85% expected at ppc.

Morphology and Classification: Major components of these soils are classified as Mollic, and Lithic Eutroboralfs and Typic Argiborolls, fine, or clayey-skeletal, montmorillonitic, deep, moderately deep and, shallow (TES map units 582, and 584). Mollic, Typic and Lithic Eutroboralfs and some Typic Argiborolls, fine, or clayey-skeletal, montmorillonitic, deep, moderately deep, and shallow. Surface textures are gravelly to extremely stony loams, or fine sandy loams and are clayey and sometimes rocky throughout. These soils are indicative of forest soils with herbaceous, grassy interspaces. Soils in TES map units 582, and 584 are Mollisols indicative of highly herbaceous understories with large interspaces. They formed from colluvium and residuum derived from basalt and cinders and are 10 – more than 40 inches to bedrock.

Soil Condition: Soil condition is satisfactory. These soils have a slight to severe (on slopes more than 40%) water erosion hazard. Maintenance of effective vegetative ground cover is essential on steeper slopes to prevent accelerated erosion.

Ecological Condition (EC and PPC compared): In general, tree and shrub canopy covers are variable with some areas less and some areas more than what is predicted in the ppc but overall diversity is close to the ppc. The ppc predicts overstory at about 65% but if canopy covers are managed at current ranges (35 – 50% or less), the herbaceous understory should increase in composition and become more productive. Diversity is variable but overall, is about the same as the ppc. Many sites have high regeneration of ponderosa pine, and gambel oak seedlings perhaps due to lack of natural fire. Machine piling may have caused higher than normal amounts of oak regeneration. Overall, shrub composition is somewhat variable and composition and diversity generally is a little lower than the ppc.

Because the soils in TES map units 582, and 584 are indicative of grassland-like soils, it is believed that the predicted TES potential tree canopy cover of 65% is too high to produce highly herbaceous understories with large interspaces (pers, comm. Rory Steinke). A more reasonable ppc tree canopy cover might be nearer to 35 – 45%. For other Ponderosa Pine TES map units, it is also believed that the TES predicted ppc tree canopy cover of 65% is higher than what would be expected to maintain highly diverse understories under low-intensity, natural recurring ground fire disturbances. A more reasonable tree canopy cover might be 40 – 50% (pers. Comm./ Rory Steinke).

Graminoid and forb composition and diversity vary somewhat and is less than or about equal to the ppc. Arizona fescue composition is generally lower than predicted in the ppc. Most sites are dominated by several perennial species.

Disturbances (Human, Drought, Flood, Fire, Pathogens, etc.) Recent drought has reduced the herbaceous understory composition, and productivity in some area. Past fire suppression in some areas has caused in increase in tree density. Grazing may have further reduced the herbaceous understory in some areas.

Fire Regime and Condition Class. Ponderosa pine stands on Anderson Mesa are in Condition Classes 2 and, to a lesser extent, 3. The historic fire regime has been altered due to fire suppression resulting in multiple missed fire intervals. Potential fire intensity, severity, extent and duration have increased. Fire suppression has resulted in increased stand densities and, with the exception of recently established open grown trees, decreased growth and vigor of individual trees of all size classes. Decreased vigor results in increased susceptibility to pathogens and parasites such as drought, bark beetles and mistletoe. Large and small-scale patches of mortality have occurred over the past few years because of the aforementioned influences on tree vigor. This mortality may increase the risk and hazard of future ignitions until the needles fall but will increase the potential surface fire intensity for many years as dead trees fall and become heavy surface fuel that will burn for long periods of time with localized high intensity.

Noxious weeds and invasive exotic plants. The extent of noxious weeds and invasive exotic plants in this unit is unknown. Several exotic species, such as spreading wall flower and cheatgrass may exist in this unit, as well as other, undetected species. Open spaces created by beetle-killed trees may be prone to invasion by weedy species. Additionally, the increased risk of severity and extent of catastrophic fire as discussed above in the fire section would increase the risk of noxious weeds and invasive exotic plants. Some areas in this unit share a similar risk of invasion as in the ponderosa unit above, based on their proximity to major roads. For a more complete discussion of noxious weeds and invasive exotic plants, please see the Botany Specialist's Report on file in the Project Record.

Table X Existing and Potential Vegetative Ground Cover (VGC) and Tree Canopy Cover

VEGETATION TYPE	TES EXISTING VGC (RANGE) PERCENT	TES EXISTING VGC (AVERAGE) TES PERCENT	TES PPC VGC PERCENT	FERA EXISTING TREE CANOPY COVER PERCENT	TES PPC TREE CANOPY COVER PERCENT
Wet Meadow	0 - 80	80	90	0 - 10	0
Montane Meadow	5 - 80	10 - 45	55 - 90	0 - 40	<5
Western wheatgrass/Blue grama grasslands (pinyon-juniper lifezone)	3 - 55	10 - 25	35 - 45	0 - 40	Trace
Non-Stocked PJ (crested wheatgrass)	5 - 65	20	40 - 50	0 - 60	Trace
Pinyon-Juniper Woodlands	5 - 65	10 - 35	30 - 65	20 - 80	35 - 50
Pinyon-Juniper Blue Grama Woodlands	3 - 40	10 - 30	40 – 45	40 - 60	40
Ponderosa Pine/AZ Fescue/Blue Grama	5 - 90	25 – 55	65 - 70	20 - 70	55
Ponderosa Pine/Gambel Oak	30 - 95	40 – 80	85	30 - 70	55 - 70

Threatened, Endangered and Sensitive Plant Species:

There are 20 Threatened, Endangered and Sensitive Species present on the Coconino National Forest but only one known population (*Hedeoma diffusum*) is located on the landscape. Table X shows this species and other species with potential habitat on the mesa. Please see Project Record #XX for detailed descriptions of these species and their potential habitat.

Table 1. TES Plants or Potential Habitats in the Anderson Mesa Analysis Area.

Scientific Name	Common Name	Status	Known locations in the Analysis Area	Potential Habitat in the Analysis Area	Comments
Arenaria aberrans	Mt. Dellenbaugh sandwort	S	No	?	No confirmed locations on Forest. Habitat includes parks and meadows
Astragalus rusbyi	Rusby milkvetch	S	No	Yes	No known locations in project area, but basalt soils in the Analysis Area may provide habitat
Cimicifuga arizonica	Arizona Bugbane	S	No	? Shady canyons	Habitat limited to canyons, drainages with mixed conifer and deciduous understory.
Erigeron saxatalis	Cliff fleabane	S	No	Yes	Habitat is Coconino Sandstone in canyon walls, possibly in East Clear Creek
Hedeoma diffusum	Flagstaff pennyroyal	S	Yes	Yes	Known from area near Marshall Mesa Tank
Helenium arizonicum	Arizona Sneezeweed	S	No	Yes	Habitat includes wetland areas such as intermittent streams and natural water sources
Heuchera eastwoodiae	Eastwood alumroot	S	No	?	Known from areas such as Workman Creek on Tonto National Forest, no known locations on Coconino National Forest
Penstemon nudiflorus	Flagstaff beardtongue	S	No	Yes	Distribution includes open ponderosa pine and pinyon-juniper forests

Identified Mollosols (Grassland Soils)

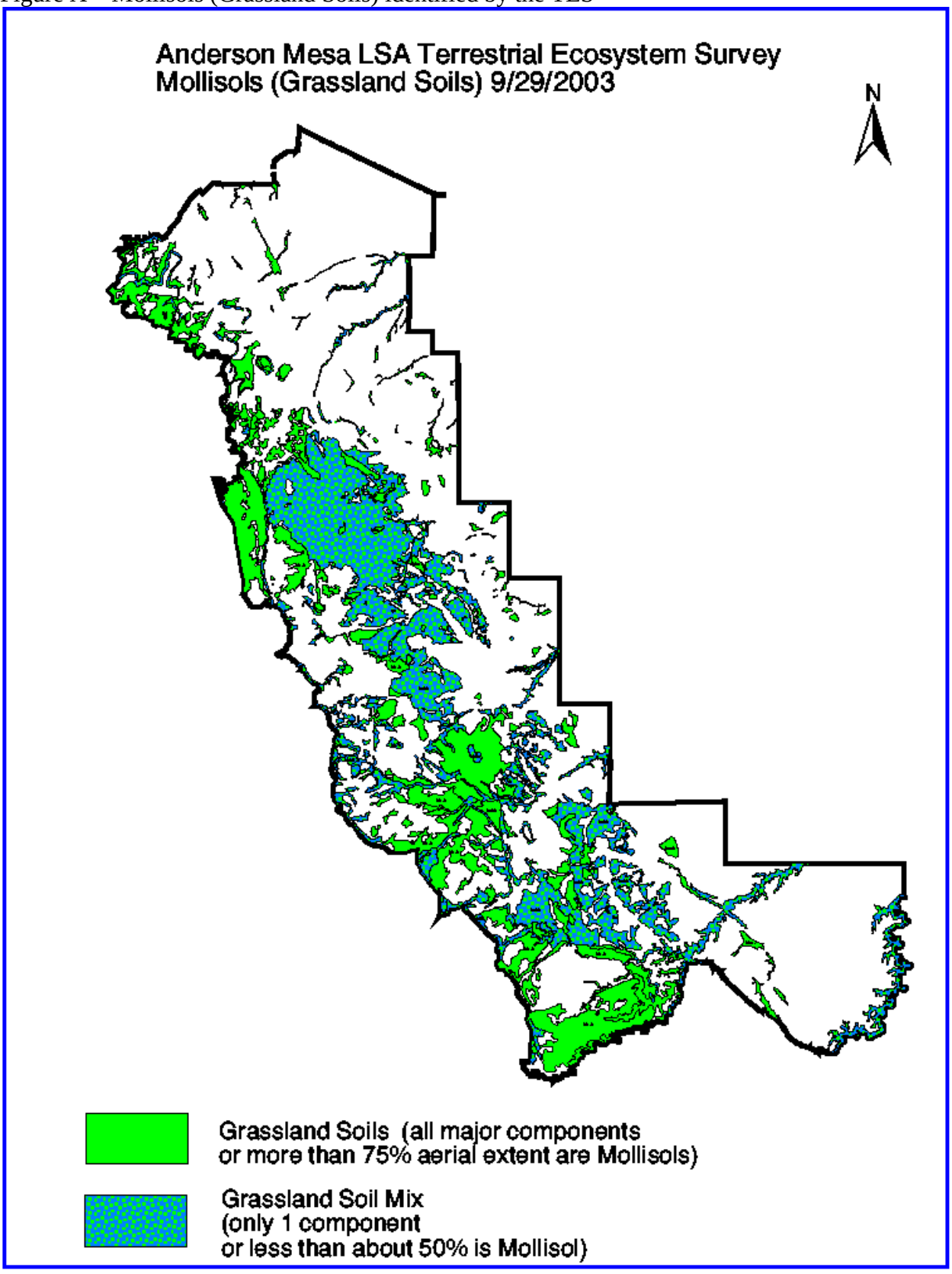
Mollisols were mapped and identified during the TES and are displayed in **Figure X** below.

Mollisols are one of 12 soil order classifications and are characterized by very dark colored, fairly highly organic and base-rich soil surfaces common in grasslands. The TES identified 14 map units with at least one component classified as a Mollisol. On the Anderson Mesa landscape, these soils likely formed under grassland vegetation types or under pinyon-juniper woodland or ponderosa pine forest types with low canopy covers and high grassy interspaces.

Table X Vegetation type, acres and TES map unit numbers identified as Mollisols.

Vegetation Type	Mollisol (Grassland-like) Composition	TES Map Units	Acres
Wet Meadows	All major components or > 90%	50	464
Montane Meadows	All major components or > 90%	41, 53, 55	5508
Western Wheatgrass/Blue Grama Grasslands	Some to most components or > 45 - 85%	453, 515	55,044
Non-Stocked Pinyon-Juniper	No components	436, 454	32,250
Pinyon-Juniper /Blue Grama Woodlands	All major components or > 75 – 85%	438, 440	6664
Pinyon-Juniper Woodlands	No major components or < about 10%	433, 434, 435, 437,439, 441, 455,465, 490, 491	109,915
Ponderosa Pine/PJ/AZ Fescue/Blue Grama	1 or more major components or about 60 – 80 % and Mollic integrade	523, 524, 527	35,810
Ponderosa Pine/Gambel Oak	No major components or < about 15%	550, 555, 654, 565, 567, 575, 578, 579, 582, 584, 585, 586, 654	16,446

Figure X – Mollisols (Grassland Soils) identified by the TES



Soil Condition by Vegetation Type and TES Map Unit

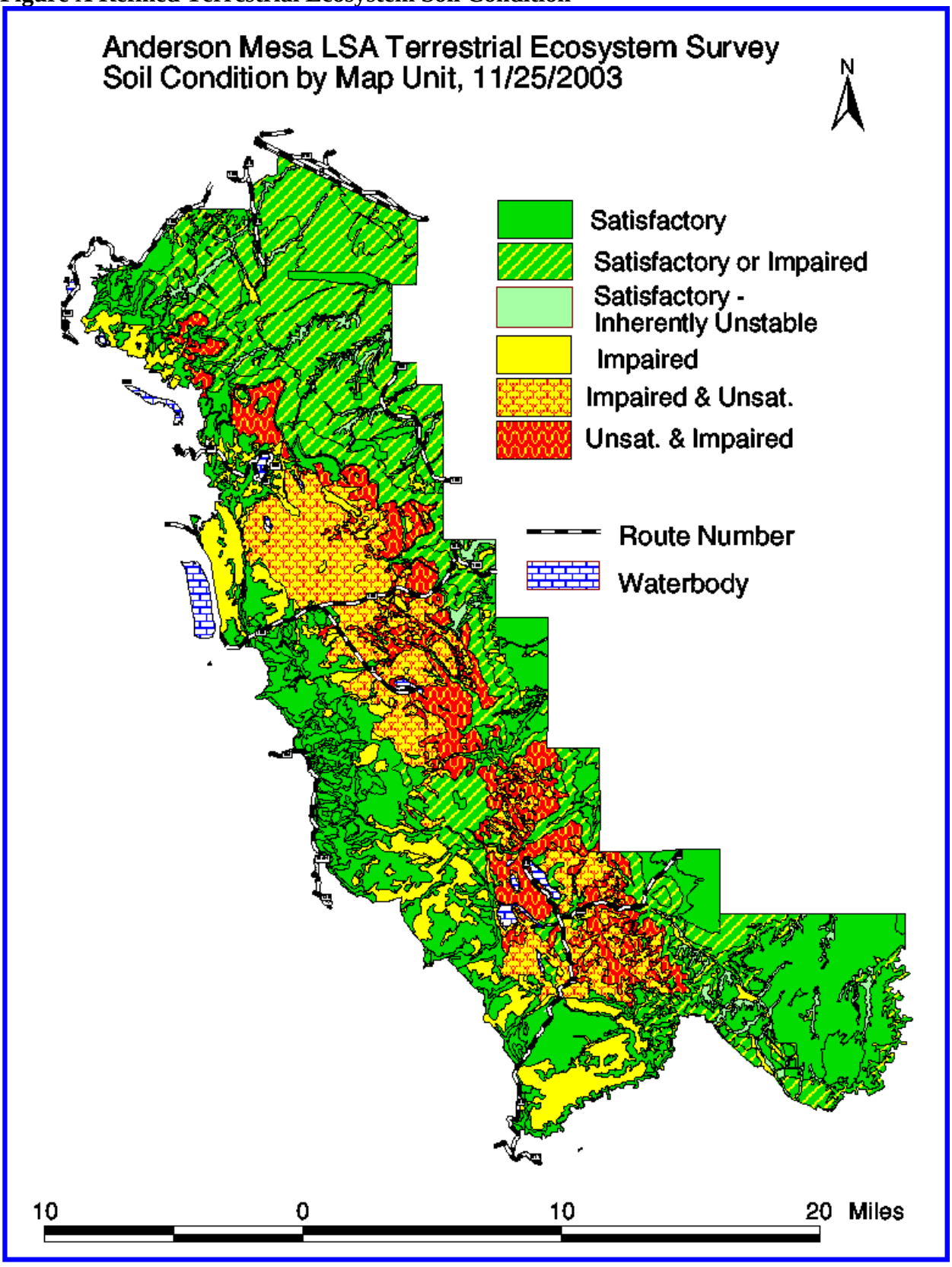
Table 2X displays soil condition, and associated acreage by vegetation type and TES map unit.

Table 2X

VEGETATION TYPE	TES MAP UNIT	SOIL CONDITION	ACRES
Wet Meadow (sedge/spikerush)	50	Impaired and Satisfactory	464
Montane Meadow	41, 53, 55	Impaired	5508
Western wheatgrass/Blue grama grasslands	453, 515	Impaired and Unsatisfactory	55,044
Non-Stocked Pinyon-Juniper	436, 454	Satisfactory	32,250
Pinyon-Juniper/Blue Grama Woodlands	438, 440	Satisfactory and Impaired	6664
Pinyon-Juniper/Woodlands	433, 434, 435, 437, 439, 441, 455, 465, 490, 491	All Classes, Satisfactory, Impaired, Unsatisfactory and Satisfactory-Inherently Unstable	109,915
Ponderosa Pine/AZ Fescue/Blue	523, 524, 527	Satisfactory	35,810
Ponderosa Pine/Gambel Oak	550, 555, 565, 567, 575,578, 579, 582,584, 585, 586, 654	Satisfactory	16,446

Figure X displays the soil condition map in the LSA area.

Figure X Refined Terrestrial Ecosystem Soil Condition



Summary of Soil Condition by TES Map Units:

Soil conditions are variable and are dependant on soil type, climate, existing vegetation type, effective vegetative ground cover, and past disturbances. **Table 3X** summarizes soil condition classes, acreages, and relative percent of landscape. **See Figure X** for precise locations of soil condition.

Soil Condition Class	Acres	Relative Percent of Landscape
Satisfactory	84,508	32
Satisfactory and Impaired	80,109	30
Satisfactory Inherently Unstable	8183	3
Impaired	25,891	10
Impaired and Unsatisfactory	34,661	13
Unsatisfactory and Impaired	28,464	11
Water, 1984	1637	<1

The majority of the landscape has **satisfactory or satisfactory and impaired soil conditions.** Analysis of all combinations of impaired classes (at least one soil condition class impaired) amount to 169,125 acres or 64% of the landscape.

Satisfactory Soils: Satisfactory soil conditions amounts to 84,508 acres or about 32 percent of the landscape. Indicators signify that soil function is being sustained and soil is functioning properly and normally. The ability of the soil to maintain resource values and sustain outputs is high. Areas with satisfactory soil condition are found predominantly in ponderosa pine on all slopes, or pinyon juniper vegetation types located on slopes ranging from about 0–15% under tree canopy covers with less than about 40%. The exception is TES unit 465, where conditions are impaired and unsatisfactory.

Satisfactory and Impaired Soils: Areas in this class are found on Pinyon-Juniper Woodlands, Pinyon-Juniper/Blue Grama Woodlands and Wet Meadows. These areas amount to 80,109 acres or about 30% of the landscape.

Satisfactory –Inherently Unstable soils account for about 8183 acres or about 3% of the landscape. These naturally erosive calcareous soils are formed in limestone and are found in pinyon-juniper woodlands on slopes ranging from 15-40 %. These soils are eroding faster than they are renewing themselves but are functioning properly and normally.

Impaired soils account for about 25,891 acres or about 10% of the landscape. Impaired soils are found on flat slopes on montane meadows or western wheatgrass/blue grama grasslands. Indicators signify a reduction in soil function. The ability of the soil to function properly and normally has been reduced due to poor nutrient cycling as a result in part from recent drought conditions and high levels of historic ungulate grazing resulting in reduced carrying capacity today. Impaired soils risk increased vulnerability to degradation.

Impaired and Unsatisfactory soil conditions account for about 34,661 acres or about 13% of the landscape. The majority of the soils are probably impaired with intermingled portions unsatisfactory. These clayey soils occur on flat slopes (TES map unit 453) in western wheatgrass/blue grama grasslands.

Unsatisfactory and Impaired soil conditions account for about 28,464 acres or about 11% of the landscape. These clayey soils occur on flat slopes on Pinyon-Juniper Woodlands (TES map unit 465) where canopy cover s are greater than about 40.

The majority probably have unsatisfactory soils (located in overstocked pj canopy covers) but has almost equal amounts of impaired soils (located in sparsely covered pj canopies). Little on-site soil condition data was collected to evaluate all three-soil functions. Therefore, soil condition class is based mostly on professional knowledge and experience gained from visual observations in similar woodlands outside of the landscape on other parts of the Coconino, Prescott and Tonto National Forests (Rory Steinke, 6/10/2003). In general, where pinyon-juniper canopy coverages exceed their potential (usually more than 40-50% total canopy cover) as predicted by the TES, herbaceous understory, effective vegetated ground cover, and soil nutrient cycling function becomes impaired or unsatisfactory and results in accelerated sheet, and rill erosion. For impaired soils, the ability to function properly and normally has been reduced due to decreased nutrient cycling due in part to recent drought and high levels of historic ungulate grazing resulting in reduced carrying capacity today. For unsatisfactory soils, indicators signify that a loss of soil function has occurred. Degradation of vital soil functions has resulted in the inability of the soil to maintain resource values, sustain outputs or recover rapidly from impacts.

Landscape-Wide Disturbances:

Disturbances were identified by vegetation type above. Landscape-wide disturbances include ungulate grazing, recreational impact, drought, pathogens and fire.

Climate Effect on Vegetation: A string of recent dry years has occurred for northern Arizona from 1995 though 2001 and beyond, (National Weather Service Public Information Statement, Flagstaff, Arizona, May 31, 2002) and has produced a combined deficit of 35.71 inches of precipitation ath the Flagstaff airport from 1995 through 2002. Julio Betancourt, Desert Laboratory, USGS and University of AZ reported at the 2003 Southwest Drought Summit that since 1999, the southwestern U.S. has been gripped by persistent drought, particularly in 2002. The effect has been more than a million acres of pinyon and ponderosa tree dieoffs in Arizona and New Mexico and up to half million acre fires along the AZ Mogollon Rim including the recent Mormon and Lizard wildfires just east of Anderson Mesa. Warmer and increasingly longer growing seasons cast troubling uncertainty about plant succession and movement in the wake of large-scale disturbances (Betancourt, 2003 SW Drought Summit). On Anderson Mesa, drought has severely reduced the vegetation composition, productivity and effective ground cover in all vegetation types except semi permanent and reservoir wetlands.

Climate Effect on Wildlife: During the 2003 Southwest drought Summit in Phoenix AZ, Brenda Smith (USFWS) reported that the population of the related Sonoran pronghorn in the U.S. has declined from an estimated 142 animals in 1998 to 21 in December 2002. Drought can have mild to severe effects and coupled with other stress factors, drought can drive threatened and endangered species (antelope and leopard frogs) closer to extinction.

Past Grazing and Fire: Past ungulate grazing and decadal fire suppression has allowed pinyon-juniper woodlands to expand. Excessive grazing likely contributed to overstocked woodlands and select ponderosa pine vegetation types by reducing vegetation ladders and eliminating the ability of the herbaceous understory to carry low intensity fire necessary to eliminate

encroaching pinyon-juniper seedlings. Drought has reduced the vegetative understory and the ability of fire to carry also. A more detailed assessment of the role of fire follows.

Pathogens and Fire History Landscape Wide

Fire played a dominant role in the pre-settlement period for the Coconino National Forest (NF). During this time plant communities were shaped by fire and the health of most ecosystems was influenced by fire (Moody et. al. 1992). Pre-settlement fires in most ecosystems frequently spread over large areas in the abundant grass. As settlement began in the late 1870s to 1880s, large numbers of grazing livestock utilized much of the annual grass production, leaving little fuel to promote the spread of wildfires. Early settlers built homes and began working in forest environments and saw wildfires as a threat to their homes and livelihood. Fire as a threat to man needed to be suppressed, and it was.

Pearson (1950) and Shubert (1974) noted that prolific ponderosa pine regeneration occurred in 1919 in the Flagstaff area. This was due to cool and wet climatic conditions that occurred in the early 1900s and 1910s. The cool wet conditions promoted seed production, germination, and seedling establishment. Grazing reduced competition and fire occurrence, contributing to long-term survival of seedlings. Other seedling establishment events occurred in the 20th century in the southwest, notably in the early 1950's. While these events are well documented for ponderosa, they are not well documented for pinyon and juniper. It has been suggested however that the same combination of early 1900s "climatological and biological events" resulted in similar prolific pinyon and juniper seedling establishment and survival (Ffolliott and Gottfried, 2002).

Exclusion of wildfires from many of the ecosystems caused changes to occur including:

- Fuel buildups that would eventually lead to large crown-replacing and catastrophic wildfires
- Understory seedlings in the pine forests survived in unprecedented numbers

- Juniper and pinyon seedlings began surviving in grass savannas

Ponderosa Pine Existing Condition: Many of the ponderosa pine dominated forests are overstocked and have dense pockets of understory trees intermixed with stands of larger trees. Woody fuel loadings, both live and dead, are at unnaturally high levels across the landscape. Acres burning at low intensities are well below historic levels (extreme upper levels for low intensity fires on the Coconino NF would have been 200,000+ acres per year), and acres burning at moderate and high intensities are well above historic levels (33,558 acres burned as wildfires on the Coconino NF in 1996. A majority of the acres burned were in the ponderosa pine vegetation type and in the moderate to high intensity range).

Pinyon/Juniper Existing Condition: Stands of pinyon and juniper that existed prior to European settlement presently exist in most of their historic locations. Some historic pinyon-juniper stands were bulldozed or chained and currently exist in an early seral state. Fire frequencies and intensities are not well documented for the assessment area particularly for grasslands and pinyon-juniper woodlands. As a result, both historic and current fire regimes are based primarily on qualitative professional judgement.

The frequency for low intensity fires has expanded somewhat in pinyon and juniper woodlands and probably ranges from 10 to 50+ years due to suppression activities. Live and dead/down fuel loadings are elevated from historic conditions as a result of fire exclusion. Pinyon and juniper trees that existed prior to European settlement have grown and matured, and are providing elements of "old growth" (snags, dead/down material, hiding and thermal cover, etc.). Young pinyon and juniper have established and have grown to a size that reduces their susceptibility to low intensity surface fires. This establishment of young trees has occurred on sites ranging from rocky poor soils to sites with deep mollisol or grassland type soils. Sites with poor rocky soils would likely have had less frequent surface fire than sites on grassland soil types due to a lack of herbaceous surface fuels surface exposure of nonflammable rock. Woody canopy cover and live fuel loading for these sites continue to increase as young trees grow and occupy more canopy space, resulting in increasing crown fire potential. This is true for pinyon-juniper woodlands that exist on poor rocky soils and on productive grassland soils. There is evidence of ongoing woodland expansion into grassland interspaces primarily by juniper but also some pinyon. The rate of this expansion is currently unknown.

The frequency for high intensity (crown) fires is still within the historic range of 100 to 500+ years, but this could change if the practice of fire exclusion continues. Historically, wildfires were dependent upon drought conditions to generate fire intensities in PJ that would result in crown fires. Drought conditions are still needed to generate crown fires, but as more young trees become established and provide ladder fuels, and as the large trees become older and decadent (numerous dead limbs in the crown causing a high dead/live fuel ratio), these stands will be at greater risk for high intensity wildfires. The Lizard and Mormon fires of 2003 exemplified the conditions required for large-scale fire spread in pinyon-juniper woodlands with sparse herbaceous fuel. Both of these fires occurred on the north end of the assessment area in early June in woodlands with high levels of dead standing and down woody fuel resulting primarily from bark beetle mortality in pinyon pine. These lightning fires were carried on the surface by dead woody fuels and in crowns as a result of low live fuel moisture and ample heating from woody fuels. Low live and dead fuel moistures combined with hot, dry, and windy pre-monsoon weather provided the ideal combination of conditions necessary for fire spread in mature pinyon-juniper woodlands. The extended site-specific effects of these fires on soils, vegetation, and wildlife are as yet unknown.

Riparian/Wet Meadow Existing Condition: Many of the riparian areas on the Coconino NF are considered to be declining in health, vigor, and distribution. Although exclusion of wildfires has caused an imbalance in environmental actions that help to maintain riparian areas, it is not considered to be a primary factor at present. The decline is attributed more to a variety of other factors including overgrazing by ungulates and diversion of surface and underground sources of water that help to maintain the health and integrity of riparian areas.

Existing Condition, Shrub Areas: Most cliffrose, mountain mahogany, and other associated shrubs that occur primarily on the north and east edges of the assessment area within and below the escarpment are currently old plants that are not successfully regenerating primarily due to lack of seedbed preparation resulting from fire. Associated fuel loads are also increasing overtime, increasing the potential for mortality in existing shrubs. Buckbrush, *Ceanothus greggii,* is not regenerating well due to lack of seed scarification and seedbed preparation. Shading from overstory ponderosa and browse are reducing plant size and vigor. Broom snakeweed appears to be regenerating well as does rabbit brush.

Grassland Fire History: Grasslands on Anderson Mesa are influenced by fire. Fire improves the health and vigor of many of the plants, affects the productivity of the soils, and reduces competition from invading shrubs and trees from neighboring woodlands. The historic fire frequency ranged from 5-30 years with intensities varying dependent upon fine fuel moistures and amount of dead fuels present. Many fires were large, landscape-sized fires or complexes of multiple fires. Fire events that covered large areas often occurred in dry years following one or more years of good production. Most large fires occurred in summer months due to the high incidence of lightning.

Existing Condition: Grazing (removal of fine fuels that historically carried wildfires) and exclusion of wildfires has allowed expansion of trees and shrubs into areas that were historically grasslands. In many cases and over large portions of the Anderson Mesa assessment area, this expansion has resulted in vegetation type changes. Areas that were historically grasslands or sparsely treed savannas are now heavily stocked stands of pinyon-juniper woodland or young stands of ponderosa pine forest. In addition it is possible that fire exclusion coupled with non-native ungulate grazing may have resulted in uncharacteristic species composition changes in the herbaceous communities on Anderson Mesa. The fire frequency, although it is not specifically known, for grasslands on Anderson Mesa over the past century is substantially greater than 30 years. Attempts to apply prescribed fire in grasslands on Anderson Mesa have been made as recently as the fall of 2003. Thus far, all recorded attempts have had poor results generally due to discontinuous or inadequate herbaceous fuel. It is important to note however that some attempts at prescribed grassland burning have been made in areas cleared of their historic pinyon-juniper woodlands by mechanical means in an attempt to expand grazing lands. These sites may not have been historic grasslands and may not have the potential to grow sufficient quantities of herbaceous fuel to carry fire.

Landscape-Wide Potential Desired Conditions:

Vegetation (boiler plate draft): Perennial plant composition, and productivity is high with maximum species diversity of vegetation expressed during periods of years of normal precipitation. Canopy cover and vegetative ground cover approximate conditions of the potential plant community.

Soil Condition (boiler plate draft): Soil conditions are satisfactory and functioning within their inherent capability and long-term soil productivity is maintained or improved. The ability of the soil to maintain resource values, sustain outputs, and recover from impacts is high. Satisfactory soils exhibit minimal on-site soil loss from erosion; absorb water quickly enough to prevent puddling, surface runoff, and overland flow, except during extraordinary rainfall events; and contain organic matter sufficient to support a complete nutrient cycle.

More Specific Desired Conditions or Possible Standards and Guidelines:

- On identified mollisols soil types, manage for grasslands in meadow types (TES 41, 50, 53 and 55).
- Manage for grasslands with little to no tree canopy cover on Western Wheatgrass/Blue Grama Grasslands.
- Manage for highly herbaceous interspaces on Pinyon-Juniper/Blue Grama Woodland vegetation type (TES map units 438, 440), and consider treatments to get there.

- Where tree canopy covers are less than about 10% on Pinyon-Juniper/Blue Grama Woodlands, and adjacent to grasslands, consider managing the patch as a grassland.
- Manage for highly herbaceous interspaces on Ponderosa Pine/PJ/AZ /Fescue/Blue Grama vegetation type (TES map units 523, 524, 527) to accentuate biodiversity.
- Where tree canopy covers are less than about 15% and adjacent to grasslands, consider managing the patch as a grassland.
- Consider managing for highly herbaceous interspaces and a lower canopy cover than the ppc for Mollisol units (TES map units 582 and 584). Maybe aim for about 40% tree canopy cover.
- Allow Non-Stocked PJ Woodlands to revert back to a mosaic of Non-Stocked and stocked PJ Woodlands because they do not have grassland potential.
- On pinyon juniper types with less than 50% surface rock cove (Dick's observations), manage canopies at less than 35%-40% to maintain or improve soil condition and accentuate biodiversity.
- Manage for a mix of seral stages across each vegetative life zone.
- Maintain or improve soil conditions to satisfactory.
- Maintain or improve biodiversity in understory vegetative types across the landscape.
- Crested wheatgrass is an exotic species and has been implicated in some noxious weed invasions so it would be better if we could replace this with a native species in non-stocked pinyon/juniper types.

Tickler List of Opportunities to move from EC to DC:

- Many Pinyon-Juniper Woodlands are overstocked especially middle and southern (TES map unit 465, 438, 439), based on FERA and TES existing canopy covers information. Undocumented and documented observations show that for pj woodlands associated with these map units, as canopy approaches or exceeds the amount listed in the ppc or about 40% overall, herbaceous understory declines and soil condition becomes impaired or unsatisfactory. Please see FERA canopy cover map entitled FERA Forest Ecosystem Restoration and Analysis LANDSAT Canopy Cover by TES Vegetation Type, October 31, 2003 located in the project record for site-specific canopy cover locations.

- Northern portions of TES map unit 465 (Pinyon-Juniper Woodlands are well understocked and may be a candidate for tree removal to create more favorable conditions for grassland production. Please see FERA canopy cover map entitled FERA Forest Ecosystem Restoration and Analysis LANDSAT Canopy Cover by TES Vegetation Type, October 31, 2003 located in the project record for site-specific canopy cover locations.

- Portions of Ponderosa pine vegetation types are overstocked. Please see the **Project Record # XX** to view the FERA map with vegetation type by 10% canopy cover intervals for site-specific areas.

- Existing vegetative groundcovers should be brought closer to potential vegetative ground covers to stabilize soil, improve soil nutrient cycling, and improve soil structure and infiltration and long-term soil and vegetation productivity.

Diablo Trust Future Landscape/ Resource Base Goals -

We share the goal of having healthy and living soils, which underwrite all of our landscape and
base resource goals. We share the belief that health and living soils are the base for a healthy and sustainable human community.

Detailed Desired Future Conditions for each of the six vegetation zones that the Diablo Trust is divided into are described in the Range Management Plan. Specific land resource goals for each are as follows:

1. ZONE 1 Western forest: high elevation/ high average precipitation.

DESIRED LANDSCAPE DESCRIPTION: We envision a true forest type with various Aged trees, including but not limited to ponderosa pine, Douglas and white fir, aspen, maple, oaks, and alligator juniper. Trees occur "clumped" with open areas of grass and create a meadow-type appearance. There is an open forest structure, with canopies and under-story open enough to withstand periodic fire. There is optimum plant and animal variety and multi-aged cool and warm season species of grasses (mountain, spike, and bull muhly, Arizona fescue, blue and sideoats grama, spike, black, and pine dropseed, poas, western and intermediate wheatgrass, weeping lovegrass, and bottlebrush squirreltail), forbs, and shrubs are present. Grasses produce enough fine fuels that under proper grazing they would carry a grass fire periodically. A multitude of springs and seeps provide additional diversity, and in these areas we find riparian type vegetation and micro habitats. Deer and turkey are back to historic levels. Soils are covered with 80% live vegetation and litter.

2. ZONE 2 West-central woodland/forest; high elevation/ moderate sporadic average precipitation.

DESIRED LANDSCAPE DESCRIPTION: The Diablo Trust envisions a Pinyon Juniper savannah with tall forest on less than 20% of the area. Deep soil sites are covered with diverse stands of grasses and shrubs. Areas close to the rim, where soils are shallow steep or uneven, will remain as PJ woodland with little change. Draw bottoms are fully covered with live vegetation. Small potholes appear at abrupt grade changes, held in place by well vegetated bottoms. Canyons contain a full complement of willows, cottonwoods, aspen, walnut, etc. present in mixed age stands. Significant cover on alluvial deposits lining canyon bottoms to create small pools of water. Intermittent lake bottoms are covered with perennial vegetation, with permanent watering sites located within the bottoms. Many of the intermittent lakes have deciduous tree windbreaks. Several historic springs and seeps have been restored. Soils covered with 70% live vegetation and litter and rocks.

3. ZONE 3 Central PJ woodland/ grassland; mid elevation, low precipitation, open breaks.

DESIRED LANDSCAPE DESCRIPTION: Diablo Trust envisions a pinyon juniper Savannah with diverse plant cover. The current diversity of the PJ type along the rock stringers along the major canyons and escarpments will be maintained. There will be an extensive, diverse, and well developed browse/shrub community with healthy mixed age classes, and diverse grassland communities with cool and warm season grasses. Draw bottoms will be

covered with vegetation, with small water pools where grade changes in shallow draws. Cottonwood and walnut trees will be growing in the smaller draws, like Draw #2, Yeager Draw, Melborne Draw, and Lower Dog Valley. Soils will be covered with 60% or more live vegetation and litter and rock, with less than 40% bare ground.

4. ZONE 4 East-central shrub/grassland; low elevation; low and highly variable precipitation.

DESIRED LANDSCAPE DESCRIPTION: Diablo Trust envisions a grassland and mixed Browse community. PJ will be maintained on shallow soils in draws, rim rocks, and slopes with north aspects. Draw bottoms will be covered with diverse grasses and browse, and small pools will be evident. There will be a greater component of cool season grasses. Deciduous trees, such as cottonwoods, poplars, and other fast growing species will be established at water points for bird with live vegetation, litter and rock, with under 40% bare ground.

5. ZONE 5 Eastern desert grasslands; very low elevation, variable low precipitation

DESIRED LANDSCAPE DESCRIPTION: Diablo Trust envisions a grassland and browse community. Vegetation will include sacaton, blue, black, and sideoats grama, galleta, and squirreltail. These grasses will be interspersed with diverse forbs and shrubs, including: fourwing, winterfat, and sage. There will be more trees in the canyon bottoms and bottomlands. Steep slopes with very shallow soils will have abundant cliffrose, shadscale, and Begelow sage. Soil will have about 70% ground cover in bottoms; ground cover will be about 50% on shallower soils with some slope, and over 10% on rocky slopes.

6. ZONE 6 Canyons and riparian areas within zones 1-5; low to high elevation, perennial water most of the year due to run-off and surface water.

DESIRED LANDSCAPE DESCRIPTION: Diablo Trust envisions the major canyons have diverse plant communities of varied age and species composition, and with soil cover and perennial grass cover adequate to stabilize the riparian ecosystem. To mitigate the impacts of floods, appropriate patterns of over story vegetation will be encouraged. Stream sinuosity will beencouraged in order to maintain deposition points. Water pooling will occur at grate changes. Lakes will have perennial vegetation to full-level waterlines, and as much below the water line as possible. The vegetation and soil treatments planned for forestlands, woodlands, and rangeland watershed areas of the Diablo Trust will significantly increase the available water and soil moisture within the lakes, canyons, and riparian areas.

ECC Final Vision Statements:

VEGETATION

♦ Within areas where woody vegetation was removed by mechanical means in the past, some places have soil conditions that can support grass cover over the long term. These places remain in predominately open grasslands of a wide variety of grasses and forbs, with pine stringers, and corridors that provide for diverse habitats. Where soils cannot support grass cover over the long term, trees are allowed to fill in to add variety to the landscape. (This generally

applies to TES (Terrestrial Ecosystem Survey) units 436 and 454. See TES unit definitions in Existing Conditions Section.)

♦ In wooded areas functioning as transitional wildlife habitat zones, the overstories and understories are in variable densities and provide diverse vegetative species and structures. Small openings (0.1 to 10 acres) are scattered through the zone. We see larger openings where they are compatible with site conditions and management objectives.

♦ The steep slopes and soils that are incompatible with openings continue to be predominately woodlands in diverse conditions. (These are generally on TES (Terrestrial Ecosytem Survey) units 455, 435, and 437. See TES unit definitions in Existing Conditions Section.)

♦ We see sites revegetated with native species where compatible with site conditions and management objectives.

SOIL CONDITIONS

♦ Soil quality is in a satisfactory condition. Soil quality is being sustained, and the soil is functioning properly and normally within its maximum inherent potential. The ability of the soil to maintain resource values, sustain outputs, and recover from impacts is high. We evaluate soil condition using three factors: rate of soil loss, rate of water infiltration, and organic content. We sort soils into three condition classes: satisfactory, impaired, and unsatisfactory. Satisfactory soils exhibit minimal on-site soil loss from erosion; absorb water quickly enough to prevent puddling, surface runoff, and overland flow, except during extraordinary rainfall events; and contain organic matter sufficient to support a complete nutrient cycle. Impaired soils fail to meet the standard for satisfactory in one of the three factors. Unsatisfactory soils fail to meet the standard for satisfactory in two or more of the three factors.

Adequacy of Forest Plan by Management Areas (assess Forest-wide and Management Area S&G's, and management emphasis for adequacy of direction in relationship to current science and management issues).

Initial thoughts: May include Desired Condition Statements

- **Cross between MA 10 (Grassland and Sparse PJ) and MA 7 (PJ Woodland , 40% Slopes).** Analyze the 2 vegetation types, Pinyon-Juniper Blue Grama Woodlands and Ponderosa Pine/AZ Fescue/Blue Grama **MA 3 (Ponderosa Pine/Mixed Conifer)** to see if there is a need to develop 2 new management areas. The emphasis is to manage towards reduced tree canopy covers and increased herbaceous undestories, interspaces on these Mollisol (grassland soils). Especially in low canopy covers and adjacent to identified grasslands. Consider S&G's to improve herbaceous understory composition and include thinning below a certain canopy cover.

- **MA 9 Mountain Grasslands: -** This area should include Montane Meadows identified on Anderson Mesa in Mountain Grassland Management Areas with emphasis for improved veg and soil condition. Identify S&G's of minimum utilization or productivity and effective veg ground cover during periods of normal years of ppt. Since productivity varies according to precipitation, consider a statement such as maintain at least 50% of herbaceous vegetation by weight, of what is produced that year.

- During project-level planning, refine on-site soil conditions at each meadow to more accurately assess soil conditions and herbaceous productivity. Identify unsatisfactory- and impaired soil conditions and annual, potential herbaceous productivity. Use structural (fences) and non-structural improvements (grazing rotations) to prevent negative grazing effects in unsatisfactory or impaired soils or in years with low herbaceous productivity.

- **MA 12 Riparian and Open Water:** Basically same as MA 9 Statements above.

- Consider S&G's on ponderosa Pine/Gambel Oak type to improve herbaceous undestories in interspaces in areas where Mollisol soils prevail (TES units 582, and 584). Consider thinning below a certain canopy cover.

- For Woodlands, consider S&G's emphasizing soil and veg condition. Perhaps thinning below 40% canopy cover, lop & scatter and in areas with low canopy cover of trees and adjacent to grasslands, consider managing towards large herbaceous interspaces.

- For pushed woodland areas, consider direction allowing them to go back into PJ stands in non-Mollisol soils and leave and mosaic.

Landscape-Wide Standards: Soil conditions rated as impaired or unsatisfactory indicate there is a need to investigate the ecosystem on-site to determine the cause and degree of decline in soil functions. Changes in land management practices or other preventative measures may be appropriate in order to avoid severe impairment to soil productivity. Maintain at least 75% of effective, vegetated ground cover (litter and vegetative basal area) estimated to be produced that year (this one would need to be measured). Maintain satisfactory soil conditions and improve

impaired soil conditions by one soil condition class within about 10 years. Improve unsatisfactory soil conditions incrementally to impaired and then to satisfactory over the long-term (likely more than 10 years). Monitor vegetative biomass, soil condition and effective ground cover by selecting representative sites or key areas.

More Specific Desired Conditions or Possible Standards and Guidelines:

- On identified mollisols soil types, manage for grasslands in meadow types (TES 41, 50, 53 and 55).
- Manage for grasslands with little to no tree canopy cover on Western Wheatgrass/Blue Grama Grasslands.
- Manage for highly herbaceous interspaces on Pinyon-Juniper/Blue Grama Woodland vegetation type (TES map units 438, 440), and consider treatments to get there.
- Where tree canopy covers are less than about 10% on Pinyon-Juniper/Blue Grama Woodlands, and adjacent to grasslands, consider managing the patch as a grassland.
- Manage for highly herbaceous interspaces on Ponderosa Pine/PJ/AZ /Fescue/Blue Grama vegetation type (TES map units 523, 524, 527) to accentuate biodiversity.
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- Allow Non-Stocked PJ Woodlands to revert back to a mosaic of Non-Stocked and stocked PJ Woodlands because they do not have grassland potential.
- On pinyon juniper types with less than 50% surface rock cove (Dick's observations), manage canopies at less than 35%-40% to maintain or improve soil condition and accentuate biodiversity.
- Manage for a mix of seral stages across each vegetative life zone.
- Maintain or improve soil conditions to satisfactory.
- Maintain or improve biodiversity in understory vegetative types across the landscape.
- Crested wheatgrass is an exotic species and has been implicated in some noxious weed invasions so it would be better if we could replace this with a native species in non-stocked pinyon/juniper types.

APPENDIX X – ANDERSON MESA TES SOIL CLASSIFICATION

Link to http://alic.arid.arizona.edu/tes/tes.html**)** for soil classification and detailed description of TES map units.

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